PHASE III
FINAL REPORT

Targeted Surveys

WISCONSIN

A Report of the Relationship of Pavement Quality with Driver Satisfaction

PUBLIC PERCEPTIONS OF THE MIDWEST'S PAVEMENTS

Submitted to the WISCONSIN DOT

Prepared by the Marquette University Research Team

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EXECUTIVE SUMMARY

The stratified sample furnished by WisDOT and the participants recruited by the WSRL provided a sample adequate for purposes of fulfilling the objectives of Phase III. The sample as furnished by the DOT was skewed towards better pavement quality based on PDI. However, the sample based on IRI was skewed toward poorer quality pavements. The team believes this shows a balanced sample, and the differences in pavement quality between the two indices are the result of the IRI boundaries for the categories. The categories in the two indices should be in closer agreement, although they measure different characteristics.

The sample size was adequate to show differences in means of those indicating they were satisfied. These differences showed up in IRI only between Flexible and Rigid Pavements. Differences in PDI showed up between the regions, the pavement types and between South Arterials and South Collectors.

Phase III results paralleled those of Phase II. In Phase III, 67 percent indicated satisfaction with the segments they were assigned to drive, and 48.5 percent indicated the pavements should be improved (vs. 80% and 54.7% respectively in Phase II). Those differences are the result of the more stratified sample in Phase III. Approximately 18 percent agreed they were satisfied (Q 57) and the pavement needed improvement (Q 59) and this was analyzed along with other relationships for a better understanding of results.

When threshold results were analyzed as in Phase II, there were substantial similarities in thresholds and the curves plotted in **Figures 3.1 and 3.2**. Differences were due to use of a more stratified sample in Phase III. For this reason a different approach to analyses was used to interpret threshold data.

Direct correlations between IRI and satisfaction (**Table 3.3**) increased approximately 50 percent (0.13 to 0.19) as predicted due to better control of segment physical data. The correlations for PDI are not comparable between the two phases since only PDI Flex was used in Phase II. But these direct correlations still explain less than 5 percent of the variation in satisfaction. Therefore as in Phase II, a psychological model is employed to explain as much of the variance as possible from the survey data.

A different approach, using assumptions about respondents answers was used to develop a tool to allow the DOT to answer questions about specific thresholds of physical indices, what percent would be satisfied and how many would agree with improvement. The assumptions are as follows:

> 1) if a pavement of a given quality results in satisfaction for a particular respondent, then it is presumed pavements of higher quality would also result in satisfaction;
>
> 2) if a pavement of a given quality is deemed to need improvement for a particular respondent, then it is presumed pavements of lower quality would also be deemed to need improvement.

Since satisfaction is a multi-dependent variable, that may not always be true, and this needs to be recognized, or else physical indices alone would account for most variance in satisfaction.

In Part 4, thresholds are developed for both IRI and PDI, by pavement type, for use of WisDOT. Thresholds for IRI are shown in **Table 4.1**, and are also shown for **Figures 4.1 through 4.3**. For example, if Wisconsin, based on this survey data, wanted to set a threshold around 2.0 for Flexible pavement improvement (middle of the "fair" category), about 45 percent would be satisfied, and about 45 percent would think it needed improvement (interpreting from **Figure 4.2**). This happens to be the intersection of the cumulative responses to Q57 (satisfied) and Q 59 (needs improvement). This would be an "optimum" IRI, i.e. any better quality pavement (lower IRI number) would satisfy more of the public, but result in less agreeing it should be improved. Any lower quality level IRI (higher IRI number) would find more agreeing pavements needed improvement, but less being satisfied. These applications are qualified, however, with the reminder that physical indices alone do not determine satisfaction, or need for improvement.

Similar analyses for Rigid pavements indicate the Q 57 and Q59 crossover or intersection point (**Figure 4.3**) is at an IRI of 2.6, below the middle of the "poor" quality category. Residents are apparently more tolerant of poorer ride on rigid pavements than on Flexible pavements (This also occurred in Iowa).

The differences in IRI are near the point where they are not practically different. If a single index for all pavements is desired, IRI seems to be more universal with fewer differences between regions, pavement types or classification. The differences in IRI for "should be improved") were in the same range. Measurement differences between Flexible and Rigid pavements may account for any difference. The team believes the categories for IRI ("good", "fair" etc. need to be adjusted however to correspond more closely to PDI pavement ratings.

When this type of analysis was applied to PDI, there were substantial differences between regions, pavement types and some difference between Arterials and Collectors. The team believes these differences are partly due to the sample skew. A review of **Table I.1** indicates 81 percent (186/229) of the sample of Rigid pavements are in the "very good" or "good" categories of PDI. Hence levels of satisfaction or need to improve are above the quality categories from the results of the IRI discussed in this section.

An "optimum" PDI (crossover or intersection point of cumulative responses to Q 57 and Q 59) of 34 (near lower boundary of the "good" condition) for all pavements (**Figure 4.4**) would include about 48 percent of those satisfied, and include 48 percent of those agreeing it needed improvement. Any higher or lower PDI would have the same affects described for IRI. Any better quality pavement (lower PDI number) would satisfy more of the public, but result in less agreeing it should be improved. Any lower quality level PDI (higher PDI number) would find more agreeing pavements needed improvement, but less being satisfied.

As noted, there are differences between regions, pavement types and some classes and the impact on thresholds are summarized here. The "optimum" PDI for all North pavements (**Figure 4.5**) is a PDI of 40 (best of the "fair" category), while the "optimum" PDI for all South pavements (**Figure 4.6**) is a PDI of 30 (middle of the "good" category). If a state-wide value is used, that for all pavements (PDI of 34) falls just about midway between that for North and South pavements.

The "optimum" PDI for all Flexible pavements (**Figure 4.7**) is a PDI 43 (near the best of the "fair" category) while the same value for Rigid pavements (**Figure 4.8**) is a PDI of 22 (near best of the "good" category. Again, these differences are believed due to the skew of the sample. Separate values are not recommended because of this. Since the differences between South Arterials and South Collectors were also noted, these differences show up in "optimum" PDIs as well. The "optimum" PDI of South Arterials (**Figure 4.9**) is a PDI of 30 (middle of the "good" category, but identical to that of all South pavements). The "optimum" PDI for South Collectors (**Figure 4.10**) is 40 (best of "fair" category, and different than all South pavements). If a PDI difference of 10 is substantial to WisDOT (the team considers this to be different) a poorer threshold for Collectors could be established. In reality, this difference in a subjective index (PDI) may not be sufficient to set different improvement thresholds for Collectors, since there are no differences noted in public satisfaction between highway classifications in the objective IRI measure.

Since physical indices alone do not explain satisfaction, the **"Expectancy Value Theory of Fishbein and Ajzen"** was used. Beliefs about pavements (Cognitive Structure) again intervene, as in Phase II, with improved path coefficients. The strength of the relationships in **Figure 5.2** are strong, and explain approximately 70 percent of the total variance. Application of the Expectancy Value Theory again showed improved understanding of other variables affecting satisfaction. In general, analysis of the Phase 3 Wisconsin data confirm the robustness of the model. This is especially true of the core relationships among physical data, cognitive structure, and satisfaction. These findings have been replicated in the analyses of the Iowa and Minnesota data. The model continues to work well not only as an explainer of satisfaction with pavements but also as a diagnostic tool. The relationships between physical data and cognitive structure continue to be impressive and consistent with expectations. The model illustrates that variables such as 1) trust in the DOT, 2) subjective norms, 3) beliefs about the pavement and 4) beliefs about some non-pavement characteristics are important considerations when attempting to understand driver satisfaction.

Special analyses were run of just a few of the questions that might be asked about the results. There is a wealth of information in the data base that can be pursued by WisDOT as the data tape has been provided. In one analysis, non-pavement beliefs are shown to be a factor determining why the public believes a highway should be improved.

The need for improvement and pavement beliefs were also compared to the drivers self evaluation of their vehicle's ride and their responses showed low correlation. In fact, almost 2/3 of those who agreed with improve and agreed with pavement beliefs affecting ride rated their ride "very good" or "good", so the team believes the vehicle ride did not impact drivers decision to agree with the need to improve.

The trust in WisDOT responses varied from slightly to significantly higher (3 to 20 percent) in Phase III than in Phase II in all four questions, indicating again, high levels of trust. The greatest level (82.3 percent) agreed that the WisDOT is capable of doing a good job in pavement repair. Levels of satisfaction differed in the two phases as well, but that is believed to be a part of the sample differences, because there was more of an over-sampling of better pavements in Phase II when motorists selected their own regularly driven section of highway..

When Xtab analyses were performed between satisfaction and all four trust questions, in general, it can be said that those who were more satisfied with the pavement, thought it was better than most and disagreed the pavement needed improvement, were more likely to agree WisDOT was capable, trusted their judgement, believed WisDOT cared about their safety and convenience and considered their input. Another way of saying it is that better pavements lead to higher trust.

Xtab analyses were also performed between each of the pavement and non-pavement beliefs as well. Agreement with trust items correlated highly with disagreement with some or most (depending on the trust question) of the negative pavement beliefs (example: pavement was bumpy, noisy) and correlated highly with two positive non-pavement beliefs (clear pavement markings and comfortable shoulders). The better vehicle ride quality was judged, the more likely respondents trusted the DOT. One driver type (lack of a CDL) showed higher trust. Demographics did not affect trust significantly.

Overall, the goals of Phase III were met and numerous relationships explored to help WisDOT answer questions about satisfaction with given pavement improvement thresholds and policies. Trust in the DOT and many other variables, again, as in Phase II, help explain just how complicated satisfaction with pavements can be, and what other beliefs and demographics affect trust and satisfaction.

BACKGROUND, PHASE II RESULTS

There are several conclusions from Phase II results in Wisconsin and in all three states that should be repeated here. Team judgements have been added in *italics* where a different approach to Phase II results may be necessary now that Phase III results are available.

- Because highways were self-selected, there was over-sampling of better highways.

- The research team theorized that the perceptions were generalized over an entire stretch of highway which participants drove, and since it was a route regularly traveled, this, too, may have affected perceptions.

- Levels of satisfaction were very high. The percent satisfied was taken as a cumulative percent, i.e., approximately 79 percent of respondents were satisfied with the highway identified, and the upper (best) limit of the pavement distress index (PDI) was 0. *It was stated that it took a PDI of near 0 to satisfy 79 percent of the public. That may have been an incorrect statement because of the way the sample was skewed. Also, it was a range of pavements from the lowest pavement included in the sample up to 0 that satisfied 79 percent in Phase II.*

- The PDI level at which 33 percent of the participants believed the pavement should be replaced was at approximately 98. *It was stated that it took a very poor PDI before only 33 percent of the participants believed a pavement should be replaced. Again, this was partly the result of sample skew.*

- The research team speculated that the answers to the policy questions (public wanted longer lasting pavements, were not tolerant of travel delays) may have influenced the above results.

- There was low direct correlation between highway physical attributes and public satisfaction. It was expected this will be higher in Phase III, but would not entirely account for satisfaction.

- The Fishbein/Ajzen model performed well in explaining public satisfaction, accounting for about 64 percent of the variance in satisfaction. This was considered "respectable" for the social sciences, when trying to predict something as complex as a person's satisfaction.

PHASE III CHANGES

Phase III sampling and survey techniques were changed to address issues identified above.

- Sampling was stratified. The sample was selected based on IRI. If IRI quality scales are used, there is an over-sampling of poorer quality roads. If PDI quality scales are used, there is an over-sampling of better roads. The sample was significantly broadened over that used in Phase II and a broad range of pavement conditions provided good results. Use of the Pavement Serviceability

Index (PSI) was reviewed by the Technical Oversight Committee and it was agreed that it would not be used. Distribution of the full interview samples before removing those with data errors is shown on the next page (**Table I.1**).

Table I.1 Sample Distribution of all Interviews in Wisconsin

Arterial Class Highways

		Pavement Type			
		Flexible		Rigid	
		IRI	PDI	IRI	PDI
North (Dist. 6, 7 & 8)	V. Good	24	25	4	53
	Good	33	33	6	51
	Fair	41	50	31	-
	Poor	35	22	41	16
	V. Poor	28	31	38	-
	Total	161	161	120	120

Collector Class Highways

		Pavement Type			
		Flexible		Rigid	
		IRI	PDI	IRI	PDI
North (Dist. 6, 7 & 8)	V. Good	32	33	-	-
	Good	24	33	-	-
	Fair	33	34	-	-
	Poor	36	30	-	-
	V. Poor	31	26	-	-
	Total	156	156	-	-

Arterial Class Highways

		Pavement Type			
		Flexible		Rigid	
		IRI	PDI	IRI	PDI
South (Dist. 1)	V. Good	28	20	23	67
	Good	25	68	12	15
	Fair	30	21	28	9
	Poor	23	21	19	18
	V. Poor	24	-	27	-
	Total	130	130	109	109

Collector Class Highways

		Pavement Type			
		Flexible		Rigid	
		IRI	PDI	IRI	PDI
South (Dist. 1)	V. Good	24	32	-	-
	Good	21	38	-	-
	Fair	32	31	-	-
	Poor	30	24	-	-
	V. Poor	30	12	-	-
	Total	137	137	-	-

Total Interviews: 813 (including those on ineligible segments)

- Participants were first recruited, then surveyed after driving the pre-selected segment. This segment may or may not have been a route driven regularly.

- Estimated times for the recruitment and post-drive interviews were 5 minutes and 8 minutes, respectively, in the project work plan. Actual interview times were approximately 6.0 minutes for the recruitment interview and 14.5 minutes for the post drive interview (about 2 minutes longer than in the other two states. Faced with the choice of requesting more funds or shortening the survey questionnaire, the research team chose to push ahead, assuming the incentive payment would reduce recruitment time, which was built into the estimate but does not show in the time stamps. The greater length of the post-drive interview was addressed by allowing sampling to be reduced to a minimum of 100 interviews per cell in all states. This reduced the amount of usable completed responses to 790 in Wisconsin, instead of 800 in the work plan. The final decision on sample size was addressed with an analysis aimed at evaluating sample homogeneity. This proved to be a reliable tactic and is addressed in the Phase III results. The response rate was 54.2 percent.

- Eight policy questions were included in Phase III in Wisconsin. This was done with the understanding the sampling would not be truly random as was Phase II. Wisconsin contributed an additional $10,000 to the Pooled Fund project for the added survey questions which were not included in other states.

- The team expected higher correlation between highway physical attributes and public satisfaction because of sampling procedures. The team expected, however, that a psychological model would be necessary to explain satisfaction. So all questions that "significantly" measured satisfaction in Phase II were included in Phase III.

INTRODUCTION TO PHASE III

There are several objectives to this report. **The first objective** is to describe the sample with regard to the physical pavement data and three measures of driver satisfaction. In this section, the proportion of respondents who are satisfied with pavements on two-lane, rural, state highways will be examined and the distribution of pavement condition and roughness indices will be presented.

The second objective will be a short description of the highway segments and any differences in satisfaction found between regions and pavement types. This was done in Phase II in each state and a letter sent showing the results in all three states. That letter set forth the revised work plan and budget for Phase III of the project.

The third objective is to describe the relationship between physical pavement characteristics and driver satisfaction. This will include a description of both the magnitude of relationship as well as identifying critical International Road Index (IRI) and Pavement Distress Index (PDI) cutoffs where a majority of the sample were satisfied. This will be done for comparative purposes with the **Phase II approach**, using the total sample to compute cumulative percentages responding to each of the three series of satisfaction questions.

It was decided by the team to present results of **Objectives 1, 2, and 3** in a manner identical to Phase II. This will allow direct comparison of the results in both phases.

A fourth objective uses the relationships between pavement characteristics and driver satisfaction to suggest ways on how to use the data to set thresholds for pavement improvement by the Wisconsin DOT.

A fifth objective is to use a psychological model (Expectancy-Value theory; Fishbein & Ajzen, 1975) to explain the nature of the relationship between satisfaction and physical pavement characteristics.
Finally, **a sixth objective** includes a few special analyses of the survey data which may be of interest to the Wisconsin DOT. The team included some of the issues and questions that could arise in reading this report. Many others are possible, but a few are included to show the kinds of analyses that are possible with the survey results.

Seven added policy questions were included in the Phase III survey, because some of the Phase II policy questions were believed by WisDOT to have consequences that were not comparable, or allowed open ended answers which were not as useful to the DOT as forcing responses into a specific speed limit or speed reduction range for example. These were included in a separate letter report to the DOT because they are Phase II issues and were not part of a random state-wide survey as was Phase II. They did not result in any major differences in responses.

Sample Description

In total, 813 Wisconsin respondents completed the survey in Phase III. After these data were collected, a number of highway segments were found to not meet inclusion criteria for the study. In total, 23 surveys

needed to be dropped from Phase III analyses, effectively reducing the sample size from 813 to 790. Additionally, Segment 33 was found to have a PDI value of zero, a value suspected by the Wisconsin DOT to be inaccurate. Six respondents were instructed to drive this segment of highway. This segment was dropped from all PDI analyses, thereby reducing the sample size from 790 to 784 for analyses involving PDI only.

The final sample (n = 790) was 52.9 percent males and 47.1 percent female. This compares with a 55 percent male and 45 percent female in the Phase II sample of 402 Wisconsin respondents. The sample was approximately normally distributed with regard to age. Approximately 27 percent of respondents were in the 18 to 35 year old age category, while 26 percent were 36 to 49 and 37 percent were aged 50 and older. Approximately 23 percent of the 790 respondents were college graduates. These percentages are very similar to figures found in Phase II, where approximately 30 percent of respondents were in the 18 to 35 year old age category, 34 percent were 36 to 49 and 36 percent were aged 50 and older. In Phase II, approximately 26 percent of the 402 respondents were college graduates.

In terms of driving frequency, 22.3 percent drove the designated highway stretch more than once a week. About a third of the sample (31.8%) drove it once a month, while only 9.2 percent reported driving the stretch once a year. Since the highway segments in Phase II were respondent-selected, no comparisons can be made. As to vehicle type, over half (56.1%) drove cars, with the next two largest vehicle types being pickup trucks (21.9%) and sport utility vehicles (10.7%). These compare with 58 percent cars, 20 percent pickups, and 12 percent minivans/vans in the Phase II sample (sport utilities were only 8%).

Respondent's self-reported vehicle ride quality was moderately skewed, with more respondents reporting a good ride quality than a poor ride quality. Specifically, 74 percent of respondents categorized their vehicle's ride quality as "good" or "very good," and only 4.3 percent categorized ride quality as "poor" or "very poor." Phase II had nearly identical frequencies with 73 percent and 4.2 percent respectively. Finally, with regard to other licenses, 11.5 percent held commercial driver licenses whereas 14.4 percent had motorcycle licenses. Phase II percentages were nearly identical with 11 percent holding CDL and 13 percent with motorcycle licenses.

OBJECTIVE 1:
DESCRIBING DRIVER SATISFACTION AND PHYSICAL PAVEMENT CHARACTERISTICS

As with Phase II of the study, respondents were asked how much they agree or disagree with three statements about the quality of a selected segment of state highway pavement which they were assigned to drive. The distribution of responses can be seen in **Table 1.1**. The analysis consists of 790 respondents. In summary, 67.3 percent (n=532) of respondents strongly agreed or somewhat agreed that they were satisfied with the pavement. Approximately half (45.8% or 362) of respondents strongly agreed or somewhat agreed that the pavement was better than most stretches

Table 1.1: Frequency and percent of respondents who agreed or disagreed with three satisfaction assessment (threshold) statements.
(Analysis includes only respondents who drove on segments that met inclusion criteria)

Value Label	Value	Frequency	Percent
Q57. I AM SATISFIED WITH THE PAVEMENT ON THIS SECTION OF HIGHWAY			
STRONGLY DISAGREE	1	113	14.3
SOMEWHAT DISAGREE	2	106	13.4
FEEL NEUTRAL	3	39	4.9
SOMEWHAT AGREE	4	223	28.2
STRONGLY AGREE	5	309	39.1
	Total	790	100.0
Q58. THE PAVEMENT ON THIS SECTION IS BETTER THAN MOST SECTIONS OF STATE HIGHWAYS I'VE DRIVEN RECENTLY.			
STRONGLY DISAGREE	1	125	15.8
SOMEWHAT DISAGREE	2	170	21.5
FEEL NEUTRAL	3	133	16.8
SOMEWHAT AGREE	4	226	28.6
STRONGLY AGREE	5	136	17.2
	Total	790	100.0
Q59. THE PAVEMENT ON THIS SECTION SHOULD BE IMPROVED			
STRONGLY DISAGREE	1	173	21.9
SOMEWHAT DISAGREE	2	154	19.5
FEEL NEUTRAL	3	80	10.1
SOMEWHAT AGREE	4	180	22.8
STRONGLY AGREE	5	203	25.7

of state highway. Likewise, approximately half (48.5% or 383) of the sample said that the pavement on their identified segment of highway should be improved. The comparable percentages from the Phase II survey were more favorable. 79 percent were satisfied, 55 percent thought the pavement was better than most and only 32 percent said the pavement should be improved. These differences may be attributable to the different methodology employed in Phase II and Phase III. In Phase II, there was an over-sampling of good highways. It is possible that respondents in Phase II self-selected good stretches of highway to drive, or tend to have a favorable bias toward roads they frequently drive.

Two physical pavement measures were analyzed for Phase III. International Roughness Index values typically range from 0 to 5 with higher values indicating a rougher pavement surface. The minimum and maximum IRI values for the highways furnished by the Wisconsin DOT in the sample were 0.66 and 5.11, respectively. Table 1.2 presents a scale to facilitate interpretation. The mean IRI value of the sample was approximately 2.2, with a standard deviation of .80. The median IRI value was also approximately 2.2. The overall shape distribution was relatively flat, with approximately equal numbers of roads in each IRI category (see below). This was by sampling design and is in contrast to the IRI distribution in Phase II, which was moderately positively skewed resulting from a proportionately greater number of highways with lower IRI values (i.e., better rides) were sampled.

Table 1.2: IRI Interpretive Categories
(as provided by Wisconsin DOT)

Range	***Interpretive Category***	***Percent of Sample***
0.00 - 1.44	Very Good	16.3
1.45 - 1.80	Good	14.2
1.81 - 2.25	Fair	23.9
2.26 - 2.90	Poor	23.2
>2.90	Very Poor	22.4

Scores on the Pavement Condition Index (PDI) values range from 0 to 100 with lower values indicating better pavement quality. The minimum (best) and maximum (worst) PDI values for highways in the sample furnished by the Wisconsin DOT were 0 and 99, respectively. **Table 1.3** presents a scale to facilitate interpretation. The mean PDI value of the sample was 39 with a standard deviation of 27. The median PDI value was 33. The overall shape of the distribution was positively skewed because a proportionately greater number of highways with lower PDI values were sampled (i.e., roads with less distress, and hence higher quality).

Table 1.3: PDI Interpretive Categories
(as provided by Wisconsin DOT)

Range	*Interpretive Category*	*Percent of Sample*
0 to 19	Very Good	25.8
20 to 39	Good	30.4
40 to 59	Fair	18.5
60 to 79	Poor	16.6
80 to 100	Very Poor	8.8

OBJECTIVE 2:
DESCRIBING THE HIGHWAY SEGMENTS SAMPLED AND TESTING FOR DIFFERENCES.

Wisconsin DOT requested sampling across two regions (North and South, with Districts 2, 3, 4 and 5 excluded) and two pavement types, (Flexible and Rigid), and two highway classes (Arterial and Collector). Within each of these cells, pavements of "excellent", "good", "fair" and "poor" quality were sampled. **Table 2.1** presents targeted numbers and actual completed interviews by pavement type, highway class, region and pavement quality. In total, 790 usable interviews were completed. This was 10 interviews shy of the targeted 800.

In analyzing differences, discussions were held with WisDOT staff. It was agreed that a statistical difference in mean satisfaction for IRI had to exceed 0.2 to 0.3 before it would be analyzed for practical differences. Also, if differences in ride tolerance result between AC and PCC pavements, it is partly attributed to the fact that unfiltered data are being used that include the effect of tining that can not be felt by the driving public inside the vehicle. The WisDOT staff believes that the same IRI may be subjectively different to real people, i.e. they may not feel the same for AC and PCC pavements. This will be discussed in the conclusions.

These discussions on statistical and real differences in PDI resulted in an agreement with the WisDOT staff that a difference less than 10 in PDI, in the upper and lower quality ranges are not practically different, but in the mid range, between a PDI of 40 to 70, they should be reviewed carefully by the research team to determine if there truly is a real difference even though that difference is less than 10 in value.

Analyses were conducted to search for differences in satisfaction as a function of highway class, region or pavement type. For these analyses, only those subjects who agreed or strongly agreed with Q57 were included (i.e., "I am satisfied with this section of highway", herein referred to as "satisfied"). These respondents were selected to identify the possible presence of mean differences in IRI and PDI cutoffs for those who are satisfied. Specifically, a series of T-tests were conducted, using IRI or PDI as the dependent variable and either, 1) region, 2) pavement type or 3) highway class as the independent variable. The T test is the appropriate statistical test to determine differences between two means. This created six series of T-tests altogether (i.e., 2 dependent variables by 3 independent variables). The logic of the analysis is as follows: If significant differences are detected, a different psychological dynamic may be needed to explain the inconsistencies and subsequent analyses may have to focus on a particular highway class, pavement type or regional subgroup. The value of P represents statistical significance, with a maximum p value of .05 required for statistical difference. The value of t can range from 0 to 7 or 8, with anything over 1.96 being significant. The sign of the t value indicates if the first value is smaller (-) or larger (+) than the second compared.

The results of the T tests are shown in **Figures 2.2 through 2.6**.

Table 2.1: Targeted and Completed Interviews by Region, Pavement Type and IRI Pavement Quality Range

Arterial Class Highways

		Pavement Type					
		Flexible			Rigid		
		T	C	F	T	C	F
North (Dist. 6,7 &8)	V. Good	20	24	24	20	4	-
	Good	20	33	33	20	6	-
	Fair	20	41	41	20	31	25
	Poor	20	35	35	20	41	41
	V. Poor	20	28	28	20	38	37
	Total	100	161	**161**	100	120	**103**

Collector Class Highways

		Pavement Type					
		Flexible			Rigid		
		T	C	F	T	C	F
North (Dist. 6,7 &8)	V. Good	20	32	32	20	-	-
	Good	20	24	24	20	-	-
	Fair	20	33	33	20	-	-
	Poor	20	36	36	20	-	-
	V. Poor	20	31	31	20	-	-
	Total	100	156	**156**	100	-	-

Arterial Class Highways

		Pavement Type					
		Flexible			Rigid		
		T	C	F	T	C	F
South (Dist.1)	V. Good	20	28	28	20	23	21
	Good	20	25	25	20	12	9
	Fair	20	30	30	20	28	28
	Poor	20	23	23	20	19	18
	V. Poor	20	24	24	20	27	27
	Total	100	130	**130**	100	109	**103**

Collector Class Highways

		Pavement Type					
		Flexible			Rigid		
		T	C	F	T	C	F
South (Dist. 1)	V. Good	20	24	24	20	-	-
	Good	20	21	21	20	-	-
	Fair	20	32	32	20	-	-
	Poor	20	30	30	20	-	-
	V. Poor	20	30	30	20	-	-
	Total	100	137	**137**	100	-	-

Note: T = Targeted interviews, C = Completed interviews by WSRL,
F = Final interviews included in analyses.

Table 2.2: Mean IRI values for those "satisfied" by Region, within and across Pavement Type and Pavement Class.

PAVEMENT GROUPS	MEAN IRI North	MEAN IRI South	t-value	P	Statistical diff.?	Practical diff.?
All Pavements	2.17 (275)[1]	2.12 (257)	.66	.50	No	No
All Arterials	2.29 (166)	2.11 (170)	2.13	.03	Yes	No
All Collectors	1.99 (109)	2.15 (87)	-1.52	.12	No	No
All Flexible Pvmnts.	2.08 (221)	2.11 (175)	-.49	.62	No	No
All Rigid Pvmnts.	2.55 (54)	2.14 (82)	4.07	.001	Yes	Maybe
Flexible Arterial	2.16 (112)	2.08 (88)	.66	.51	No	No
Rigid Arterial	2.55 (54)	2.14 (82)	4.07	.001	Yes	Maybe
Flexible Collector	1.98 (109)	2.15 (87)	-1.52	.13	No	No

[1] Sample size

Table 2.3: Mean PDI values for those "satisfied" by Region, within and across Pavement Type and Pavement Class.

PAVEMENT GROUPS	MEAN PDI North	MEAN PDI South	t-value	P	Statistical diff.?	Practical diff.?
All Pavements	43.6 (275)[1]	31.3 (254)	5.25	.001	Yes	Yes
All Arterials	41.5 (166)	28.1 (170)	4.68	.001	Yes	Yes
All Collectors	47.0 (109)	37.7 (84)	2.28	.024	Yes	Maybe
All Flexible	48.2 (221)	36.6 (172)	4.28	.001	Yes	Yes
All Rigid Pvmnts.	25.2 (54)	20.1 (82)	1.24	.218	No	No
Flexible Arterial	49.4 (112)	35.6 (88)	3.85	.001	Yes	Yes
Rigid Arterial	25.2 (54)	20.1 (82)	1.24	.218	No	No
Flexible Collector	47.0 (109)	37.7 (84)	2.28	.020	Yes	Maybe

[1] Sample Size

Table 2.4: Mean IRI values for those "satisfied" by Pavement Type, within and across Region and Pavement Class.

PAVEMENT GROUPS	MEAN IRI Flexible	Rigid	t-value	P	Statistical diff.?	Practical diff.?
All Pavements	2.09 (396)[1]	2.31 (136)	-2.78	.006	Yes	No
All Arterials	2.13 (200)	2.31 (136)	-2.05	.04	Yes	No
All North.	2.08 (221)	2.55 (54)	-4.60	.001	Yes	Yes
All South.	2.12 (175)	2.14 (82)	-.24	.81	No	No
Northern Arterial	2.17 (112)	2.55 (54)	-3.52	.001	Yes	Yes
Southern Arterial	2.09 (88)	2.15 (82)	-.46	.65	No	No

[1] Sample Size

Table 2.5: Mean PDI values for those "satisfied" by Pavement Type, within and across Region and Pavement Class.

PAVEMENT GROUPS	MEAN PDI Flexible	Rigid	t-value	P	Statistical diff.?	Practical diff.?
All Pavements	43.1 (393)[1]	22.1 (136)	8.04	.001	Yes	Yes
All Arterials	43.3 (200)	22.1 (136)	7.64	.001	Yes	Yes
All North.	48.2 (221)	25.2 (54)	5.67	.001	Yes	Yes
All South.	36.6 (172)	20.1 (82)	4.98	.001	Yes	Yes
Northern Arterial	49.4 (112)	25.2 (54)	5.92	.001	Yes	Yes
Southern Arterial	35.6 (88)	20.1 (82)	4.18	.001	Yes	Yes

[1] Sample Size

Table 2.6: Mean IRI values for those "satisfied" by Pavement Class, within and across Pavement Type and Region.

PAVEMENT GROUPS	MEAN IRI Arterial	Collector	t-value	P	Statistical diff.?	Practical diff.?
All Pavements	2.20 (336)[1]	2.06 (196)	2.07	.04	Yes	No
All Flexible	2.13 (200)	2.05 (196)	.88	.37	No	No
All North.	2.29 (166)	1.98 (109)	3.61	.001	Yes	Maybe
All South.	2.11 (170)	2.15 (87)	.34	.73	No	No
Northern Flexible	2.17 (112)	1.98 (109)	1.83	.07	No	No
Southern Flexible	2.08 (88)	2.15 (87)	.48	.631	No	No

[1] Sample Size

Table 2.7: Mean PDI values for those "satisfied" by Pavement Class, within and across Pavement Type and Region.

PAVEMENT GROUPS	MEAN PDI Arterial	Collector	t-value	P	Statistical diff.?	Practical diff.?
All Pavements	34.7 (336)[1]	42.9 (193)	3.30	.001	Yes	No
All Flexible	43.3 (200)	43.0 (193)	.13	.89	No	No
All North.	41.5 (166)	47.0 (109)	1.58	.116	No	No
All South.	28.1 (170)	37.7 (84)	2.82	.005	Yes	Maybe
Northern	49.4 (112)	47.0 (109)	.62	.54	No	No
Southern	35.6 (88)	37.7 (84)	.59	.56	No	No

[1] Sample Size

There are statistically significant differences in mean IRI values of those "satisfied", between North and South regions (see **Table 2.2**), for all arterials, all rigid pavements and rigid arterials. The difference for all arterials is not practically different (<0.2). Since there are no rigid collectors, differences will be analyzed between North and South for rigid pavements in **Objective 3**. No practical differences in mean IRI levels of satisfaction between regions are considered as discussed later in **Objective 3**.

There are statistically significant differences in mean IRI of those "satisfied", between pavement types in all pavements and all arterials (see **Table 2.4**) but these are deemed to not be practically different. The differences in mean IRI between pavement types for all North pavements and North arterials are both statistically different and practically different and will be explored in **Objectives 3** and **4**.

There are statistically significant differences in mean IRI of those "satisfied" between highway classes for all pavements (see **Table 2.6**) but these are not practically different. The statistically significant difference in mean IRI between North arterials and North collectors is just barely practically different and will be explored in **Objective 3**.

There are statistically significant differences in mean PDI values between North and South regions (**see Table 2.3**). This is true for all pavements, all arterials and all collectors, and for flexible pavements but not for rigid pavements. These will also be tested in **Objectives 3** and **4**, as these are considered real differences as well as being statistically different.

The statistically significant differences in mean PDI between pavement types in all groupings in **Table 2.5** are practically different as well and will also be explored in **Objectives 3** and **4**.

The statistically significant differences in mean PDI between all collectors and all arterials (**Table 2.7**) is less than 10 therefore deemed not practically different. The differences between South Arterials and South Collectors will be explored in **Objectives 3** and **4.**

OBJECTIVE 3:
DESCRIBING THE RELATIONSHIP BETWEEN PAVEMENT CHARACTERISTICS AND DRIVER SATISFACTION USING PHASE II METHODOLOGY

The third objective of this study is to describe the relationship between pavement characteristics and driver satisfaction. The fundamental question of when drivers are satisfied with the condition of the pavement surface has important policy implications — namely, what distress and roughness levels are tolerated by the public? This question was investigated using the same strategy employed in Phase II. IRI and PDI values were identified for the cumulative percent of respondents who agreed with each the three satisfaction questions (Q57, Q58, and Q59). Using this technique, the researchers were able to answer questions such as "at what IRI value might we expect 70 percent of all participating drivers to be satisfied with a given section of highway?" For this analysis, the three measures of satisfaction were recoded into an agree-disagree format, such that responses of "strongly agree" and "agree" coded as "1" and responses of "feel neutral," "disagree" and "strongly disagree" were coded as "0." **Table 3.1** presents IRI cutoff values as related to the statement "I am satisfied with the pavement on this section of highway." For this analysis, IRI values were ranked from high (poor) to low (good) for IRI for respondents who agreed with the three satisfaction questions. Using this distribution of decreasing IRI scores, the team pinpointed key pavement index values as a function of the cumulative percent of the sample that agrees with each of the satisfaction questions. Similar data are presented for PDI in **Table 3.2.** In each table, the 95 percent confidence intervals for pavement index scores (i.e., IRI or PDI scores) are presented at the bottom of each table. The confidence intervals were based on the standard error of the relevant pavement index.

When the IRI values in **Table 3.1** are compared to parallel analyses conducted in Phase II, we find a general consistency or similarity of the data. For example, for Phase II, the IRI values that "satisfied" 20, 30, 40, 50 and 60 percent of the sample were 2.42, 2.08 1.80, 1.57, 1.33 and 1.13. The parallel cutoffs for Phase III were 2.51, 2.18, 1.89, 1.69 and 1.26. In Phase II, 79 percent agreed that they were "satisfied" with pavement overall, whereas in Phase III, only 67.3 percent agreed with this statement. The difference is most likely a function of the distribution of the pavements sampled. By design, Phase III had a flatter, stratified distribution of pavements with approximately equal numbers of highways in the "very good", "good", "fair", "poor" and "very poor" range. By contrast, Phase II had a relative over-sampling of roads in the "good" and "very good" range. The results in Phase III should be considered more reliable because extra care was taken to ensure that the cutoffs are not purely a function of the highways sampled.

A same procedure was employed for PDI scores. The cutoff values for PDI are shown in **Table 3.2.** Again, the cutoffs were calculated for the entire sample (found at the top of the table) and for each possible subgroup of the sample. **Figures 3.1 and 3.2** are prepared from **Tables 3.1** and **3.2** and show the cumulative percent of respondents who agreed with all three questions, plotted against the respective IRI and PDI values, for all pavements.

Again, looking at the PDI data for the entire sample, Phase III results follow the same general pattern as results from Phase II. The cutoff scores are within 10 points of each other. A difference is that in Phase II, a greater overall number of respondents were "satisfied" with the pavement (generating

Table 3.1: IRI Cutoffs for Question 57
At what IRI values did X percent of the respondents agree or strongly agree with the following statement:

"I am satisfied with the pavement on this section of highway."

	Cumulative Percent							
	10%	20%	30%	40%	50%	60%	70%	% Agreed
Entire Sample	2.90	2.51	2.18	1.89	1.69	1.26	-	**67.3% or 532/790**
				North and South Regions Combined				
All Flexible	2.90	2.34	2.07	1.78	1.62	1.18	-	67.3% or 396/584
Flex. Arterials	3.28	2.48	1.99	1.85	1.63	1.09	-	67.8% or 200/291
Flex.	2.76	2.26	2.07	1.78	1.42	1.20	-	66.9% or 196/293
All Rigid	2.95	2.60	2.38	2.11	1.89	1.33	-	66.0% or 136/206
All Arterials	2.95	2.59	2.33	1.92	1.70	1.29	-	67.7% or 336/497
				Pavement Type Combined				
All North	2.9	2.57	2.23	1.91	1.70	1.20	-	65.5% or 145/420
North Arterials	2.90	2.64	2.38	1.92	1.72	1.12	-	62.9% or 166/264
South	3.06	2.29	2.13	1.85	1.64	1.31	-	69.5% or 257/370
South Arterial	3.20	2.43	2.13	1.86	1.64	1.31	.95	73.0% or 170/233
				Pavement Classes Combined				
All North Flex	2.90	2.51	2.07	1.89	1.69	1.28	-	69.7% or 221/317
All South Flex	3.28	2.26	2.00	1.77	1.42	1.04	-	65.9% or 172/261
				Individual Cells				
N Arterial Flex	2.90	2.67	1.99	1.89	1.70	1.32	-	69.6% or 112/161
N Arterial Rigid	2.90	2.64	2.57	2.23	1.80	-	-	52.4% or 54/103
N Collector	2.68	2.30	2.07	1.80	1.52	1.20	.88	69.9% or 109/156
S Arterial Flex	3.28	2.43	2.13	1.63	1.59	1.04	-	67.7% or 88/130
S Arterial Rigid	3.06	2.56	2.21	2.05	1.82	1.64	1.31	79.6% or 82/103
S Collector	2.86	2.26	2.02	1.77	1.42	1.18	-	63.5% or 87/137

a=95% Confidence Intervals equal plus or minus .05 (e.g., the CI for 2.9 would be 2.85 to 2.95).

Table 3.2: PDI Cutoffs for Question 57
At what PDI values did X percent of the respondents agree or strongly agree with the following statement:

"I am satisfied with the pavement on this section of highway."

	Cumulative Percent							
	10%	20%	30%	40%	50%	60%	70%	% Agreed
Entire Sample	71	57	36	27	15	0	-	67.5% or 529/784
North and South Regions Combined								
All Flexible	73	59	48	33	23	13	-	68.0% or 393/578
Flex. Arterials	72	59	48	33	26	13	-	68.7% or 200/291
Flex.	78	59	44	33	20	7	-	67.2% or 193/287
All Rigid	50	30	20	6	0	0	-	66.0% or 136/206
All Arterials	70	52	32	26	13	0	-	67.7% or 336/497
Pavement Type Combined								
All North	80	58	45	28	19	11	-	65.5% or 145/420
North Arterials	72	58	30	28	19	0	-	62.9% or 166/264
South	67	48	33	23	7	0	-	69.8% or 254/364
South Arterial	63	42	33	23	3	0	0	73.0% or 170/233
Pavement Classes Combined								
All North Flex	82	67	55	40	23	13	-	69.7% or 221/317
All South Flex	67	48	36	28	23	0	-	65.9% or 172/261
Individual Cells								
N Arterial Flex	81	70	58	43	27	16	-	69.6% or 112/161
N Arterial Rigid	30	28	23	15	0		-	52.4% or 54/103
N Collector	93	61	55	38	20	13	7	70% or 109/156
S Arterial Flex	63	48	33	29	23	7	-	67.7% or 88/130
S Arterial Rigid	62	42	19	3	0	0	0	79.6% or 82/103
S Collector Flex	72	56	38	27	19	0	-	64.1% or 84/131

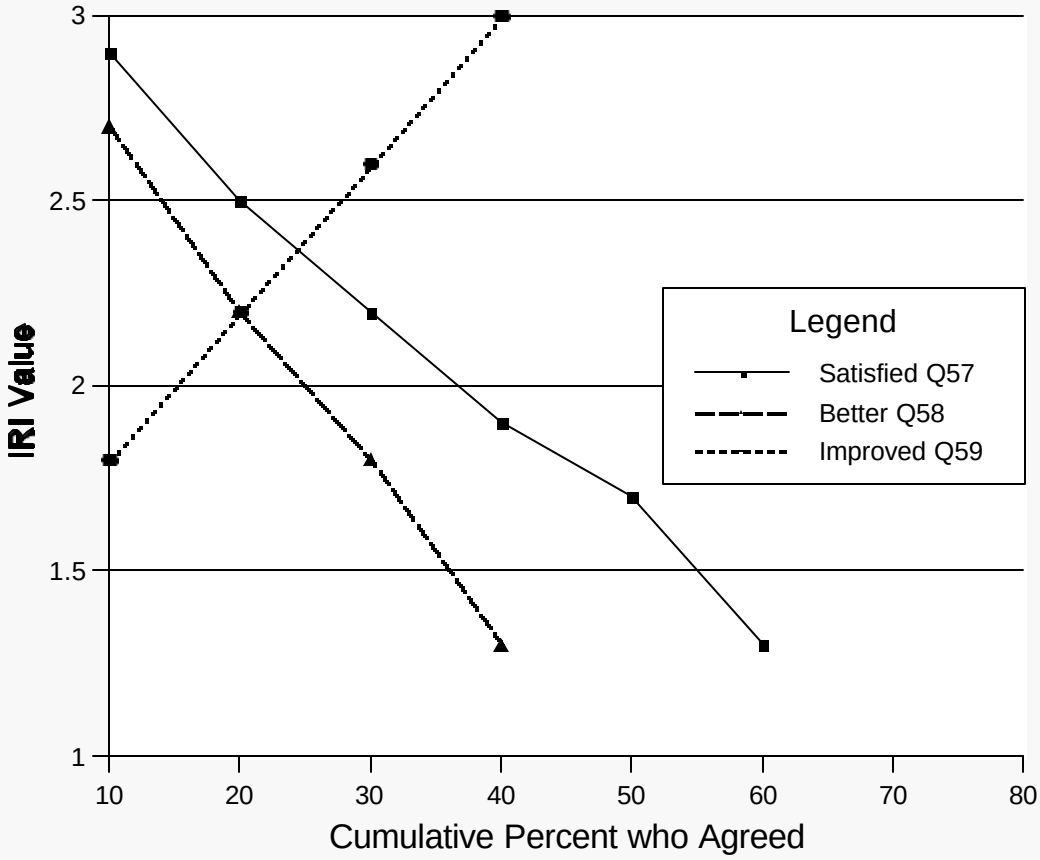
a=95% Confidence Intervals equal plus or minus 2.0 (e.g., the CI for 71 would be 69 to 73).

Figure 3.1:
At what IRI values did X% of respondents agree with the following three statements:

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



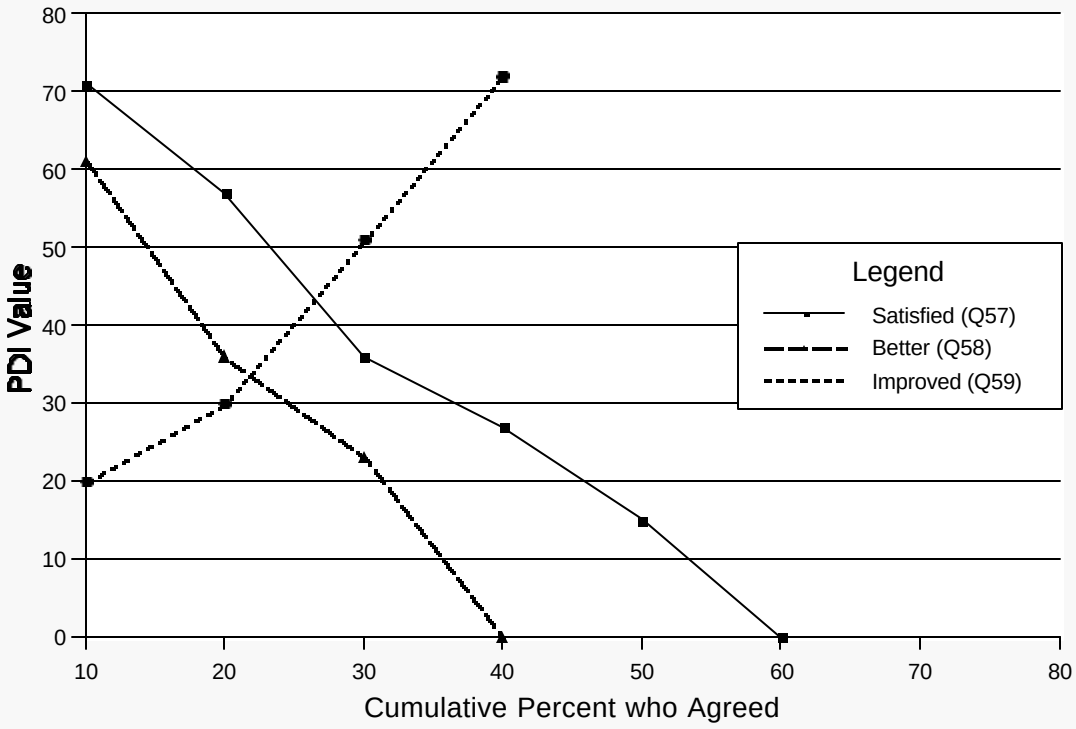
Data are graphed for the total sample (N = 790). Data for Q57 corresponds to data presented in Table 3.1.

Figure 3.2:
At what PDI values did X% of respondents agree with the following three statements:

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



Data are graphed for the total sample (N = 784). Data for Q57 corresponds to data presented in Table 3.2.

a cutoff score of 13 for 60% and 70%). These values are either 0 or non-existent for Phase III. Again, this difference can most easily be explained by differences in the sampling approach employed in each Phase.

Review of Differences Between Regions, Pavement Types and Classifications

In **Objective 2**, **Table 2.2**, there were statistical differences in mean IRI for those "satisfied" between North and South regions for rigid pavements. A review of **Table 3.1**, **lines fourteen and seventeen** (North arterial rigid and South arterial rigid, which are all the rigid pavements since there are no rigid Collectors), for all percentiles, shows a close relationship. Therefore no practical differences are considered to exist between regions for IRI in setting thresholds in **Objective 4**. Likewise, comparing **lines eleven and twelve, Table 3.1** (all North flexible and all South flexible) shows no practical differences affecting thresholds.

The differences in mean IRI shown in **Table 2.4** between flexible and rigid pavements for all North pavements were also reviewed using the data on **lines eleven and fourteen** (all North flexible and North arterial rigid) in **Table 3.1**. The differences may be practically different as well as statistically different. Similar review of lines 13 and 14 in **Table 3.1** also show there may be differences between pavement types in North arterials. Because sample size in North rigid arterials is small (54), groupings of all rigid pavements will be compared to all flexible pavements and reviewed in **Objective 4** when reviewing thresholds.

The differences in mean IRI between North arterials and North collectors (**Table 2.6**) were likewise reviewed and the differences (**lines eight and fifteen**, **Table 3.1**), although statistically significant, have no practical difference that would affect setting thresholds in **Objective 4**.

All the differences in mean PDI shown in **Table 2.3** between North and South regions are all practical, based on review of **Table 3.2**, as well as being statistically significant, and will be explored in **Objective 4**.

All differences in mean PDI, shown in **Table 2.5**, between flexible and rigid pavements are also all practical as well as statistically significant, based on a review of **Table 3.2**, and will be explored further in **Objective 4**.

Those differences in mean PDI shown in **Table 2.7** between South Arterials and South Collectors were reviewed using **lines ten and eighteen, Table 3.2**. These may be practically different and will be explored further in **Objective 4**.

Direct Correlations - Physical Indices and Measures Of Satisfaction

Finally, another way of examining the relationship between driver satisfaction and physical indices of pavement condition and roughness is to look at the zero-order (i.e., uncontrolled) correlations between these two variables. **Table 3.3** presents the relationships between these variables, including an overall

index of "satisfaction" — the summation of the three "threshold" measures of satisfaction with pavement conditions:

- "I am satisfied with the pavement on this section of highway" (Q57);
- "The pavement on this stretch of highway is better than most of the stretches of state highways I've driven in Wisconsin"(Q58);
- "The pavement on this section of highway should be improved" (Q59, reverse coded);

Respondents indicated their agreement or disagreement with each item on a five-point, Likert-type scale. Reliability (Cronbach's alpha or α[1]) for the unidimensional satisfaction index is a satisfactory 0.85. This is a measure of how consistently each of the three questions were answered. Higher scores represent greater satisfaction. The satisfaction index should have a *negative* zero-order (i.e., uncontrolled) relationship with both IRI and PDI because higher scores on both represent poorer pavement quality (rougher pavement or more distress).

As can be seen in **Table 3.3**, IRI correlated more highly with satisfaction than did PDI. All relationships were significant and in the predicted direction. As predicted, the strength of these relationships did increase slightly in magnitude over Phase II results for IRI, but decreased for PDI (Phase II included only PDI for flex pavements). Still, the magnitude of the relationship between satisfaction and pavement indices can be characterized as small. Approximately 4 percent (0.19^2) of the variance in satisfaction can be accounted for by IRI values. This means that the remaining 96 percent of the variance in satisfaction can be systematically accounted for by other variables or will remain error variance (do to measurement or sampling error, etc.). These findings reaffirm importance of using a psychological model predict and understand driver "satisfaction", a construct of considerable psychological complexity.

Another illustration of this occurs in examination of **Figure 3.2**, for PDI. If one were to connect a value of 100 in PDI (a pavement so poor it doesn't exist in the sample) and presume no one (0%) would agree they were satisfied, and draw a straight line down to a PDI of 0 (perfect pavement) and assume 100 percent would be satisfied, there is considerable space between the existing solid line representing those agreeing they were satisfied and the theoretical line described above. This shows graphically, why physical indices alone don't describe satisfaction. Other variables affect driver satisfaction.

Note: 1.

Cronbach's alpha (α) is a standard measure of the internal consistency or reliability of a summated scale. The statistic measures the extent to which the items which comprise the scale co-vary and form a scale with a single underlying dimension. A high Cronbach's alpha indicates a unidimensional scale (i.e. the component items all seem to be measuring the same underlying construct). Alpha can range from - 1 through + 1. Unacceptable alphas are any negative alpha or positive alphas less than 0.5. Marginal alphas range from 0.5 to about 0.75. Good alphas are 0.75 or above (some say 0.8 or above). The stronger the positive correlation among the items that comprise the scale, the higher the internal consistency of the scale, the higher the Cronbach's alpha value, and the lower the measurement error in the index.. Generally, acceptable alpha values are .5 or above and superb values are .8 or above.

Table 3.3: Pearson r (zero-order) correlations between satisfaction measures and indices of physical roughness and pavement condition.

	Physical Pavement Measure	
	IRI	**PDI**
(Q57) I AM SATISFIED WITH THE PAVEMENT ON THIS SECTION OF HIGHWAY.	**-.19*** **	**-.09***
(Q58) THE PAVEMENT ON THIS STRETCH OF HIGHWAY IS BETTER THAN MOST OF THE STRETCHES OF STATE HIGHWAY I'VE DRIVEN ON RECENTLY IN WISCONSIN .	**-.11*** **	**-.10****
(Q59) THE PAVEMENT ON THIS STRETCH OF HIGHWAY SHOULD BE IMPROVED.	**+ .20*** **	**+.11****
SATISFACTION INDEX (THREE QUESTIONS COMBINED, WITH Q59 REVERSE-CODED)	**-.19*** **	**-.11****

Significance key: ** p # .01 ***p# .001

OBJECTIVE 4:
DESCRIBING THE RELATIONSHIP BETWEEN PAVEMENT CHARACTERISTICS AND DRIVER SATISFACTION -
THRESHOLDS FOR PAVEMENT IMPROVEMENT FOR THE WISCONSIN DOT

Introduction

Phase III results paralleled those of Phase II, with greater accuracy because of sampling and interview procedures. However, the team believes other approaches to interpreting the data should also be utilized. Satisfaction for IRI ranged from those "satisfied" with an IRI as poor as approximately 3.3 to an IRI as good as 0.7 (estimated values), while satisfaction for PDI ranged from pavements as poor as a PDI of approximately 79 to a PDI as good as 0. Similar variations existed in the range of respondents who agreed pavements should be improved. In Phase III, however, sample size was much larger, making possible a separate analysis of each question by pavement type using just the portion of the sample that strongly agreed or agreed with the three satisfaction questions.

Because the sample was selected based on International Roughness Index (IRI), a comparison of the survey response and segment condition was reviewed from **Table I.1** and compared to sample distribution by PDI. This is also shown in **Tables 1.2** and **1.3**. The WisDOT selected samples more heavily from the "fair" to"very poor" pavement condition based on IRI (**Tables I.1, 1.2** and **2.1**). Looking at **Table 2.1**, roughly 31 percent (241 of 790) of the surveys were conducted on highways in the "good" or "very good" condition based on IRI. From **Table 1.1**, 67 percent (532 of 790) agreed they were "satisfied" with pavements. Likewise, approximately 69 percent (from **Table 1.2**) of the surveys were conducted on highways with "fair" to "very poor" pavements and approximately 46 percent (**Table 1.1**) agreed the highway should be improved. There is that overlap that needs to be explained as noted previously. Also, as noted previously, there were no practical differences in mean IRI in any region or among the pavement types (see **Objectives 2** and **3**).

A comparison of **Tables 1.2** and **1.3** shows that segment selection resulted in just the opposite result in terms of distribution of survey results based on PDI. While **Table 1.2** shows approximately 69 percent of surveys were on highways in the "fair" to "very poor" condition based on IRI, **Table 1.3** shows only 43.9 percent conducted on the same ranges of highway condition. This shows low correlation of IRI and PDI quality ranges below the "good" condition. This will be discussed later in Objective 6 and recommendations. There was difficulty finding rural two lane highway segments in the rigid category in the North region, and some selected did not meet criteria.

In **Tables 4.1, 4.2** and **4.3**, percent of sample is taken as only those who strongly agreed or agreed with the three satisfaction questions (Questions 57, 58 and 59). Hence those who disagreed or were neutral are not included. The sample size is shown in the right column. Because this is a large sample (532 for Q 57) and because the range of pavements that resulted in satisfaction is very broad, the team believes that the results of the questions can be separated and compared. If a pavement of given quality results in satisfaction for a particular respondent, it is presumed pavements of higher quality would also be satisfactory. That may not be true, because satisfaction is such a multi-dependent variable.

Table 4.1: At what IRI values did X% of respondents agree with the following three statements[a]:

Q57: *"I am satisfied with the pavement on this section of highway"*
Q58: *"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"*
Q59: *"The pavement on this section of highway should be improved"*

Cumulative Percent

Question	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	N
All Responses											
Q57	3.28	2.76	2.48	2.24	2.05	1.89	1.74	1.42	1.25	.66	532
Q58	3.36	2.78	2.53	2.26	2.07	1.89	1.74	1.42	1.28	.66	362
Q59	1.39	1.77	1.91	2.18	2.29	2.57	2.76	2.95	3.36	5.11	383
All North Pavements											
Q57	2.95	2.79	2.59	2.38	2.08	1.91	1.75	1.52	1.26	.69	275
Q58	3.01	2.87	2.64	2.48	2.23	1.91	1.75	1.52	1.28	.69	176
Q59	1.53	1.80	1.92	2.10	2.38	2.59	2.68	2.90	3.01	4.15	216
All South Pavements											
Q57	3.36	2.67	2.29	2.18	1.94	1.78	1.69	1.39	1.18	.66	257
Q58	3.42	2.67	2.29	2.21	2.00	1.82	1.69	1.39	1.25	.66	186
Q59	1.18	1.74	1.86	2.18	2.27	2.46	2.90	3.30	3.80	5.11	167
All Flexible Pavements											
Q57	3.42	2.68	2.32	2.13	1.92	1.78	1.69	1.39	1.09	.66	396
Q58	3.49	2.78	2.38	2.23	1.94	1.77	1.69	1.40	1.18	.66	265
Q59	1.20	1.70	1.85	1.94	2.13	2.30	2.64	2.90	3.48	5.11	285
All Rigid Pavements											
Q57	3.06	2.90	2.64	2.57	2.29	2.21	1.94	1.82	1.33	1.25	136
Q58	3.06	2.90	2.59	2.57	2.29	2.21	2.05	1.82	1.33	1.25	97
Q59	.89	2.21	2.56	2.59	2.60	2.90	2.95	3.01	3.36	3.72	98

a=The thresholds presented in this table were based on a cumulative distribution of IRI values for only respondents who agreed or strongly agreed with the above questions. 95% Confidence Intervals equal plus or minus .05 (e.g., the CI for 2.8 would be 2.75 to 2.85).

Table 4.2: At what PDI values did X% of respondents agree with the following three statements[a]:

***Q57:** "I am satisfied with the pavement on this section of highway"*
***Q58:** "The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"*
***Q59:** "The pavement on this section of highway should be improved"*

	Cumulative Percent										
Question	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	N
All Responses											
Q57	77	67	56	41	32	27	20	13	0	0	529
Q58	73	62	52	38	30	27	19	7	0	0	361
Q59	7	20	23	30	35	49	59	68	77	97	378
All North Pavements											
Q57	88	70	58	52	38	28	23	15	13	0	275
Q58	81	68	58	47	30	28	23	13	11	0	176
Q59	13	20	23	30	43	58	61	72	81	97	216
All South Pavements											
Q57	71	62	42	36	29	23	7	0	0	0	254
Q58	71	59	42	36	29	23	7	0	0	0	185
Q59	0	13	23	28	32	42	50	63	73	83	162
All Flexible Pavements											
Q57	82	70	58	51	38	32	23	16	7	0	393
Q58	81	67	58	48	36	30	23	13	7	0	264
Q59	13	23	28	35	48	56	61	72	80	97	280
All Rigid Pavements											
Q57	62	37	30	28	19	11	0	0	0	0	136
Q58	62	37	30	28	19	3	0	0	0	0	97
Q59	0	6	15	20	23	28	30	37	62	73	98

a=The thresholds presented in this table were based on a cumulative distribution of PDI values for only respondents who agreed or strongly agreed with the above questions. 95% Confidence Intervals equal plus or minus 2.0 (e.g., the CI for 30 would be 28 to 32).

Table 4.3: At what PDI values did X% of respondents agree with the following three statements[a]:

Q57: *"I am satisfied with the pavement on this section of highway"*
Q58: *"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"*
Q59: *"The pavement on this section of highway should be improved"*

	Cumulative Percent										
Question	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	N
					All South Arterials						
Q57	67	57	38	33	28	23	3	0	0	0	170
Q58	67	53	37	33	23	7	0	0	0	0	115
Q59	0	6	23	28	30	32	48	53	63	77	98
					All South Collectors						
Q57	73	63	56	41	36	27	23	13	0	0	84
Q58	82	72	56	41	36	28	23	23	7	0	70
Q59	13	23	27	38	42	49	63	72	73	83	64

a=The thresholds presented in this table were based on a cumulative distribution of PDI values for only respondents who agreed or strongly agreed with the above questions. 95% Confidence Intervals equal plus or minus 2.0 (e.g., the CI for 30 would be 28 to 32).

But for purposes of this analysis, this will be assumed. Subsequent analysis of the model explaining satisfaction may modify that assumption, since other variables besides pavement indices can affect satisfaction.

Likewise, if a pavement of a given quality is deemed to need improvement for a particular respondent, then it is assumed pavements of lower quality would also be deemed to need improvement. Again, there are potential fallacies in this assumption, but it will be presumed for purposes of drawing useful inferences out of a large sample size (383 for Q 59). Again, model analysis can modify that assumption.

In Phase III, some were "satisfied" with a "very poor" pavement, others required a "very good" pavement. There were 532 (**Table 1.1**) "satisfied" with pavements, yet 383 thought the pavements "should be improved", hence more than 130 respondents agreed with both "satisfied" and "should be improved." A separate analysis of those who SA or A with both Q57 ("satisfied") and Q 59 ("should be improved") is contained in **Objective 6**.

The following analyses of data included in **Tables 4.1, 4.2** and **4.3** are provided to illustrate how the data could be interpreted and used for policy analyses as a guide in setting of IRI or PDI thresholds to evaluate motorist's satisfaction with pavements and to determine the need for pavement replacement using only physical indices. Since **Table 4.1, lines four and seven**, show relatively small differences between North and South regions, separate threshold for IRI will not be developed. However, separate analyses will be performed within pavement groups. All differences for PDI will be explored in this section for the need for separate threshold.

Analysis of "Satisfied" Data - IRI - (Q57)

Wisconsin does not use a threshold of IRI for improvement alone, relying more heavily on PDI. The current boundary condition for the "fair" IRI range used by WisDOT is approximately 1.81 to 2.25 (**Table 1.2**).

All Pavements

Using the assumption that an individual respondent would be "satisfied" with a pavement quality at or above that indicated from their survey, analysis of all pavements together (**first line**, **Table 4.1** or **Figure 4.1**) could be used for public perception input in the following manner. If the lower range for "fair" IRI, (i.e. 2.25 or just above "poor") is used as a threshold for replacement by WisDOT, it would only include approximately 39 percent of those responding who agreed they were "satisfied" with pavements. If the threshold were set at an IRI of 1.8 (at the best end of the "fair" category), it would satisfy an estimated 65 percent of those who indicated "satisfied". If the threshold were set at the best limit of the "good" category (IRI = 1.45), it would include about 79 percent of those who indicated "satisfied". An IRI of 1.74 would be needed to account for 70 percent of those who indicated "satisfied". This threshold is in the "good" category. Pavement types were combined to calculate these estimates. Separate analyses for each pavement type are presented below. These analyses are based solely on physical data. That alone is insufficient, as will be shown later in Objective 5. But it does give a different approach to the **Table 3.1** results when the data is arrayed as in **Table 4.1**

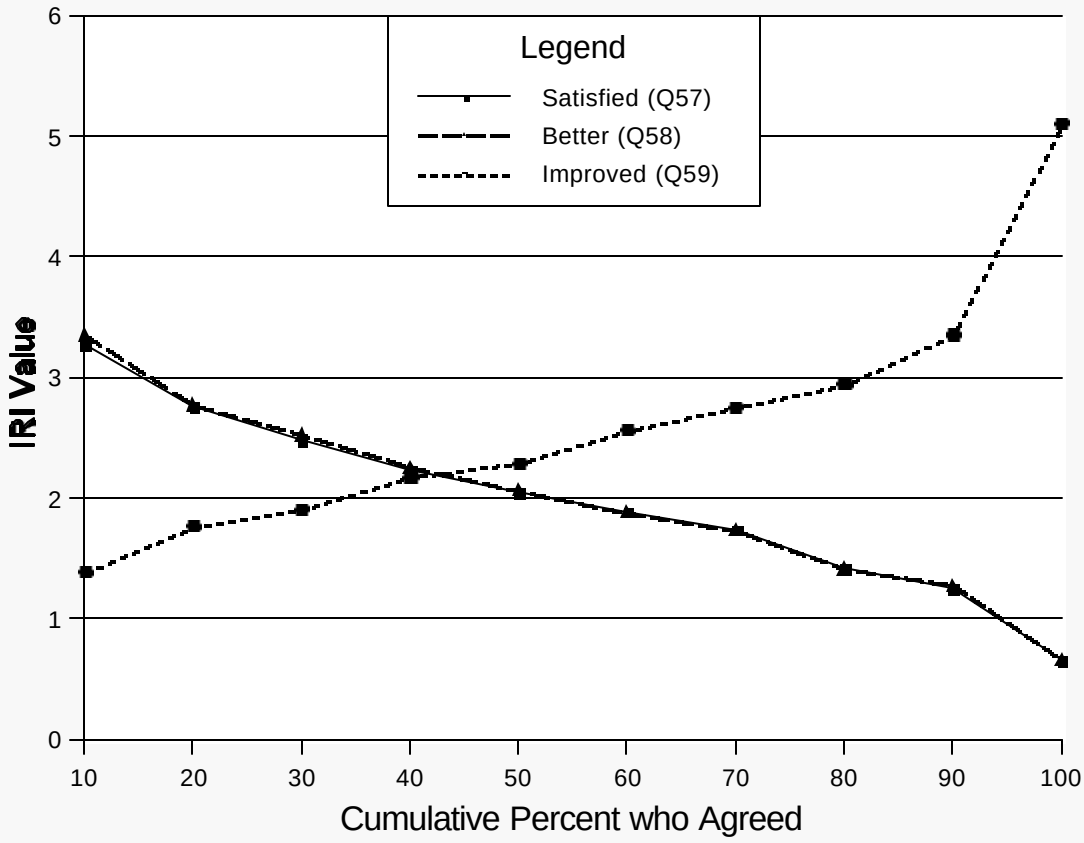
Figure 4.1:
At what IRI values did X% of respondents agree with the following three statements[a]:

(All Pavements)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



Only subjects who agreed or strongly agreed with the above questions were included in the analysis.

Flexible Pavements Only

The data in **Table 4.1** for flexible pavements are statistically significant as well as practically different than rigid pavements. Referring to the **tenth line** in **Table 4.1** or **Figure 4.2**, an analysis similar to all pavements was made. If the same boundaries of the pavement quality categories used in the preceding analysis for all pavements are applied to all flexible pavements, an IRI of 2.25. (lower range of the "fair"category) would satisfy 34 percent of those who indicated "satisfied". An IRI of 1.81 (best of the "fair") would include an estimated 57 percent of those who indicated "satisfied". A threshold IRI at the best of the "good" category (1.45) would account for an estimated 78 percent of those "satisfied". An IRI of 1.69 would be needed to account for 70 percent of those indicating "satisfied". This is close to the lower range of the "good" category.

Rigid Pavements Only

A similar approach was used for flexible pavements, and this is shown in the **thirteenth line** of **Table 4.1** or **Figure 4.3**. If the same boundaries of the pavement quality categories are applied to rigid pavements only, an IRI of 2.25 (lower range of the "fair"category) would satisfy an estimated 54 percent of those who indicated "satisfied". An IRI of 1.81 (best of the "fair") would include approximately 80 percent of those who indicated "satisfied". An IRI of 1.45 (best of the "good" category) would satisfy an estimated 88 percent of those "satisfied". An IRI of 1.94 would be needed to account for 70 percent of those indicated "satisfied". This is above the middle of the "fair" category.

Analysis of "Should Be Improved" Data - IRI - (Q59)

A similar assumption was made for Q 59 data as was made for Q 57 responses, i.e. a respondent who indicated a pavement "should be improved" at a given quality level would also agree that a pavement at a lower quality level should also be improved. Again, that may or may not be appropriate, as satisfaction is dependent on many variables. This will be explored in Objective 5 with the model testing.

All Pavements

Analysis of all pavements together (**third line**, **Table 4.1** or **Figure 4.1**) could be used for public perception input in this fashion. If the lower boundary for "good" IRI, (i.e. 1.8) or just better than "fair") is used as a threshold for replacement by the WisDOT, it would include an estimated 24 percent of those agreeing that the pavements needed improvement (hereinafter referred to as "improve"). If the threshold were set at an IRI of 2.25 (at the lower range of the "fair" category, and just above "poor"), it would include an estimated 45 percent of those who agreed with "improve". An IRI of 2.76 would account for 70 percent of those who agreed with "improve". This threshold is near the lower range of the "poor" category. Pavement type was combined to calculate these estimates. Separate analyses (within pavement type) are presented below. It should be cautioned that these analyses are based solely on physical data. That alone is insufficient, as will be shown later.

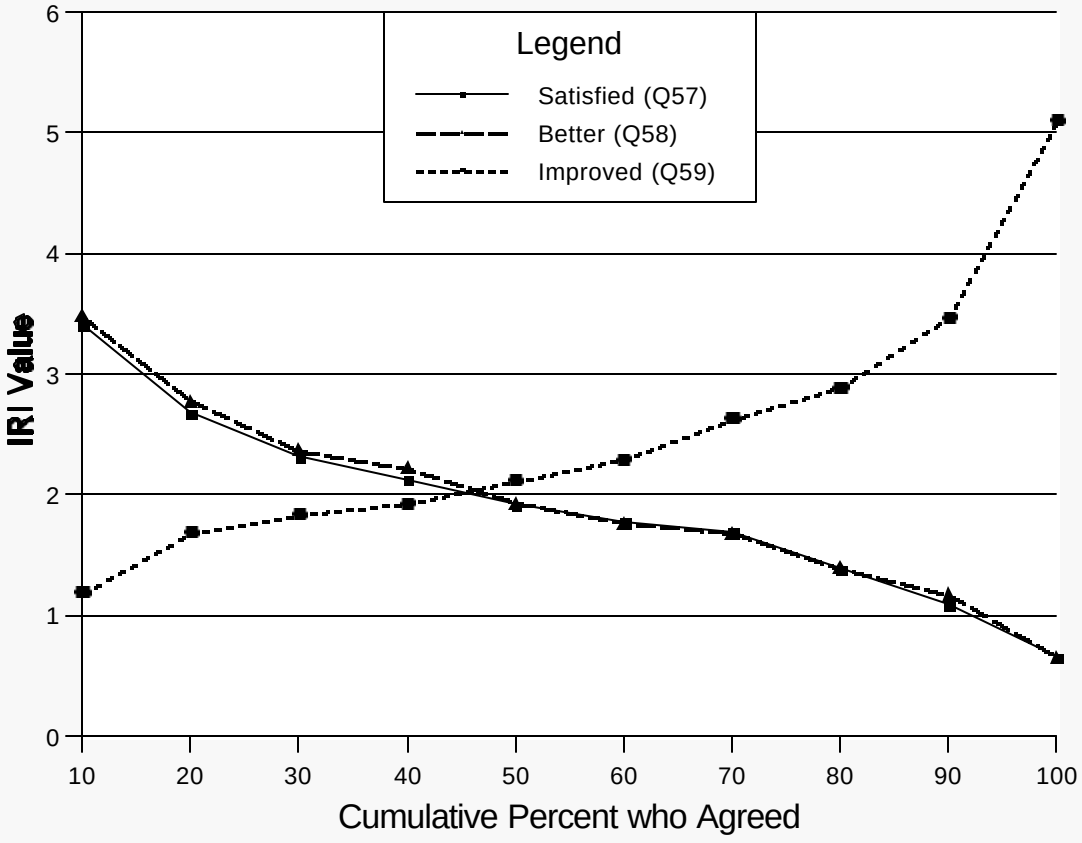
Figure 4.2:
At what IRI values did X% of respondents agree with the following three statements[a]:

(Flexible Pavements Only)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



Only subjects who agreed or strongly agreed with the above questions were included in the analysis.

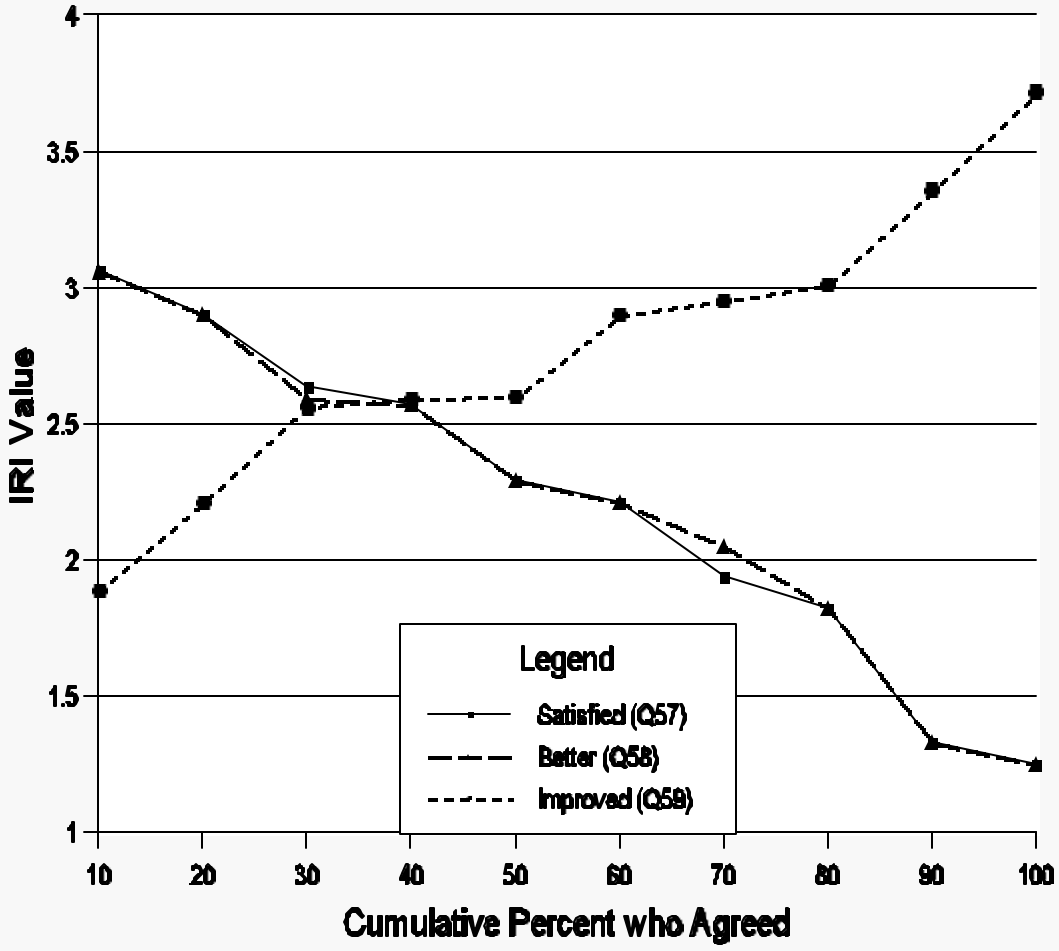
Figure 4.3:
At what IRI values did X% of respondents agree with the following three statements[a]:

(Rigid Pavements Only)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



Only subjects who agreed or strongly agreed with the above questions were included in the analysis.

But it does give a different approach to the **Table 3.1** results when the data are arrayed as in **Table 4.1**.

Flexible Pavements Only

Since satisfaction differed between rigid pavements and flexible pavements, a separate analysis like that for all pavements was conducted for each type of pavement. Using the **twelfth line** of **Table 4.1** or **Figure 4.2**, if a threshold IRI of 1.80 were set (lower range of "good" category) approximately 27 percent of those respondents who agreed with "improve" would be included. If the lower range of the "fair" category were selected (IRI of 2.25), 57 percent would be included. An IRI of 2.64 would be needed to account for 70 percent of those who agreed with "improve". This is close to the middle of the "poor" category.

Rigid Pavements Only

Since satisfaction differed between rigid and flexible pavements, separate analysis like that above was conducted, using the **fifteenth line**, **Table 4.1** or **Figure 4.3**. If a threshold of 1.80 (lower range of the "good" category) less than 10 percent of those respondents who agreed with "improve" would be included. If the lower range of the "fair" category were selected (IRI of 2.25), an estimated 22 percent would be included. An IRI of 2.95 would account for 70 percent of those who agreed with "improve". This is near the upper limit of the "very poor" category.

Analysis of "Better Than Most" - IRI - (Q 58)

All Pavements

This question is not helpful in setting a threshold by itself, but when analyzed with responses to Q 57 and Q 59, it might prove helpful. Using the **second line**, **Table 4.1** or **Figure 4.1**, if the same 70 percent level is applied to those who agreed with this question, an IRI of 1.74 would result This is well into the "good." category.

Flexible Pavements

If the same 70 percent level is applied to those who agreed with this question for flexible pavements combined, using **line eleven** in **Table 4.1** or **Figure 4.2**, an IRI of approximately 1.69 would result. This is in the "good" category.

Rigid Pavements

If the same 70 percent level is applied to those who agreed with this question for rigid pavements only, using the **fourteenth line** of **Table 4.1** or **Figure 4.3**, an IRI of approximately 2.05 would result. This is near the midpoint of the "fair." category.

Satisfaction Data - PDI - (Q 57)

Similar assumptions are made regarding satisfaction as with IRI analysis in this section. However, separate analyses were conducted for North and South regions, both pavement types and a classification difference in the South region. These are shown in **Table 4.2**and **4.3.** Again, this is the same data from

Table 3.2, displayed in a different fashion. The same analysis as that used for IRI could be used for public perception input for WisDOT, using PDI. The boundaries of the "fair" pavement condition for WisDOT are 40 to 59 while the boundaries of the "good" condition are 20 to 39 (see **Table 1.3**). Like IRI, a lower number means better pavements.

All Pavements

Using data from **Line one** of **Table 4.2** or **Figure 4.4**, if the lower boundary of the "fair" condition (PDI of 59) were used as a threshold, an estimated 27 percent of those who indicated "satisfied" would be included. If the best boundary of the "fair" were used (PDI of 40), approximately 40 percent would be included. If the threshold were set at the best of the "good" category (PDI of 20), approximately 70 percent would be included, based solely on physical data. To reiterate, physical indices explain only a small part of satisfaction.

North Pavements Only

Because North and South pavements had differences in mean levels of satisfaction that were both statistically significant and practically different as well, separated analyses of threshold levels are developed. Using data from **Line four** of **Table 4.2** or **Figure 4.5**, if the lower boundary of the "fair" condition (PDI of 59) were used as a threshold, approximately 30 percent of those who indicated "satisfied" would be included. If the best boundary of the "fair" were used (PDI of 40), approximately 49 percent would be included. If the threshold were set at the best of the "good" category (PDI of 20), approximately 74 percent would be included. If the DOT wanted to satisfy 70 percent a threshold PDI of about 23 would be required. This is near the best of the "good" category.

South Pavements Only

For South pavements, Using data from **Line seven** of **Table 4.2** or **Figure 4.6**, if the lower boundary of the "fair" condition (PDI of 59) were used as a threshold, an estimated 21 percent of those who indicated "satisfied" would be included. If the best boundary of the "fair" were used (PDI of 40), approximately 33 percent would be included. If the threshold were set at the best of the "good" category (PDI of 20), approximately 62 percent would be included. If the DOT wanted to satisfy 70 percent a threshold PDI of approximately 7 would be required. This is near the best of the "very good" category. North and South pavement thresholds are different.

Flexible Pavements Only

Because flexible and rigid pavements had differences in mean levels of satisfaction that were both statistically significant and practically different, separate analyses of threshold levels are developed. Using the **tenth line** in **Table 4.2** or **Figure 4.7**, a similar analysis was made. If the same boundaries

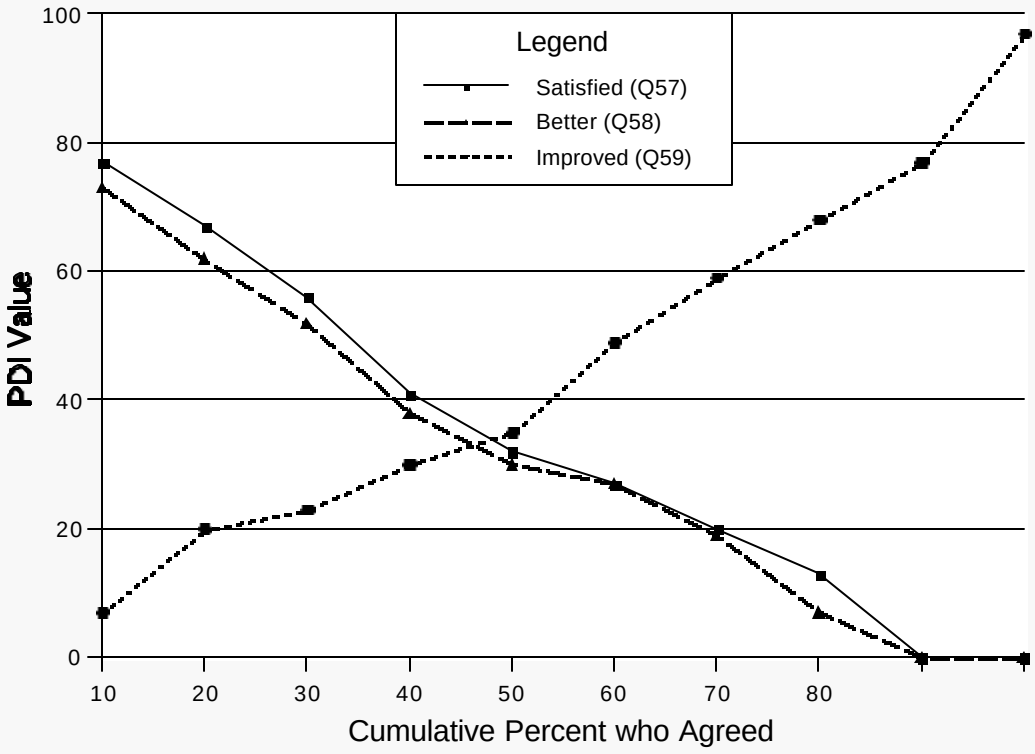
Figure 4.4:
At what PDI values did X% of respondents agree with the following three statements:

(All responses)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



Data are graphed for only those respondents who agreed or strongly agreed with the above question from Table 4.2.

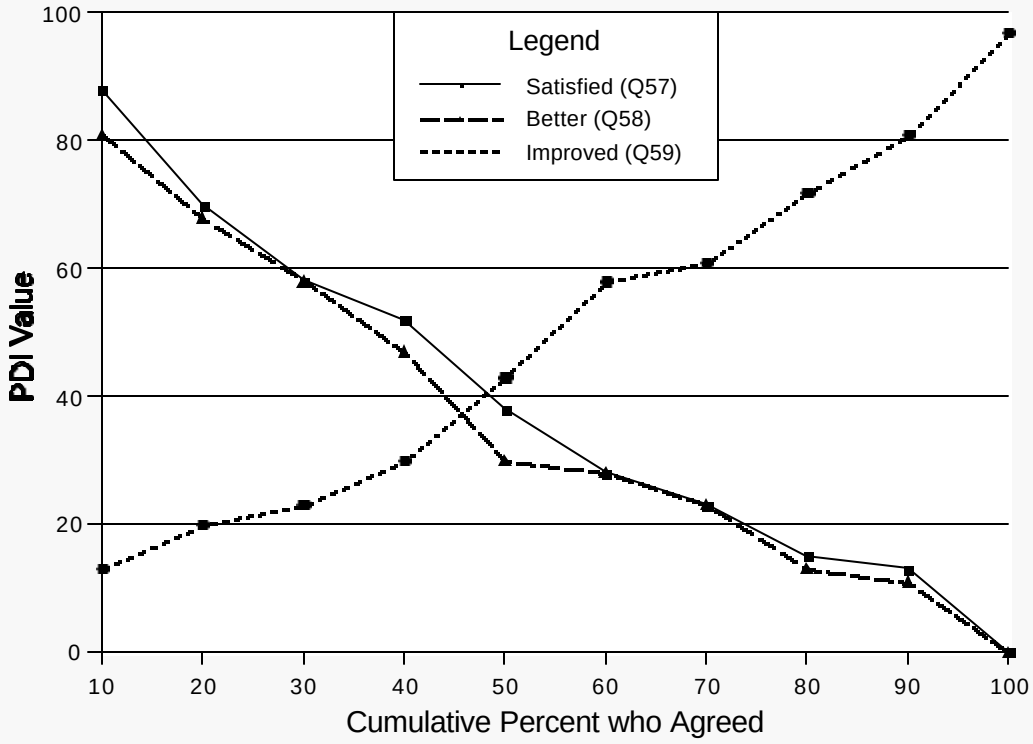
Figure 4.5:
At what PDI values did X% of respondents agree with the following three statements:

(All North)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



Data are graphed for only Northern pavements and for only those respondents who agreed or strongly agreed with the above questions. Data correspond to Table 4.2.

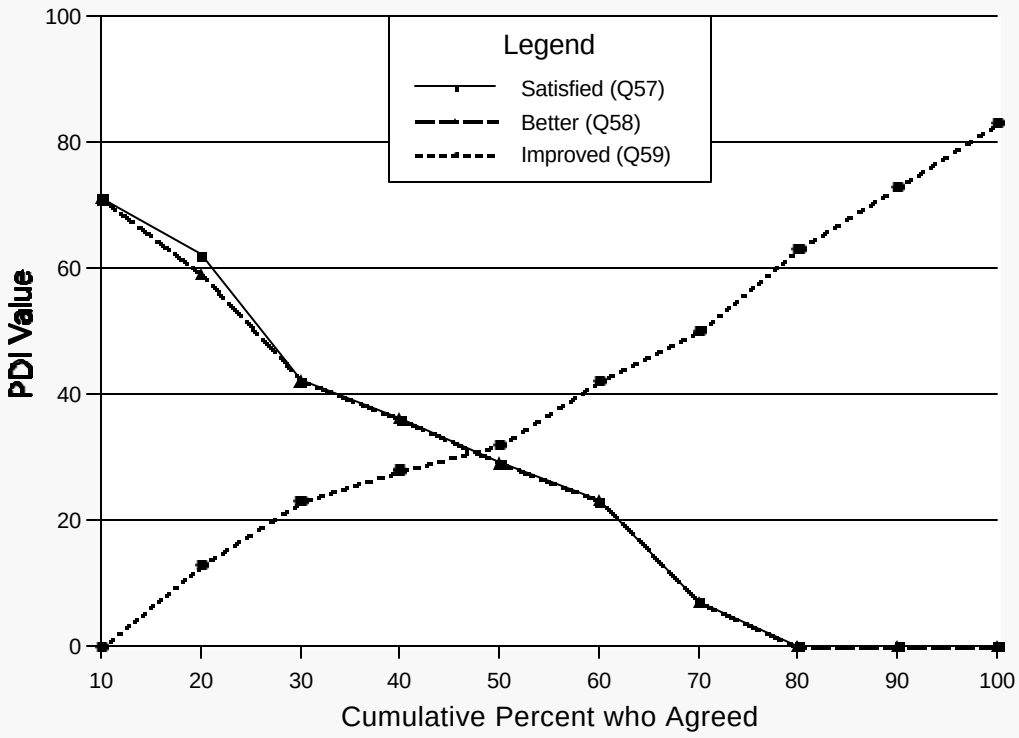
Figure 4.6:
At what PDI values did X% of respondents agree with the following three statements:

(All South)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



Data are graphed for only Southern pavements and for only those respondents who agreed or strongly agreed with the above questions. Data correspond to Table 4.2.

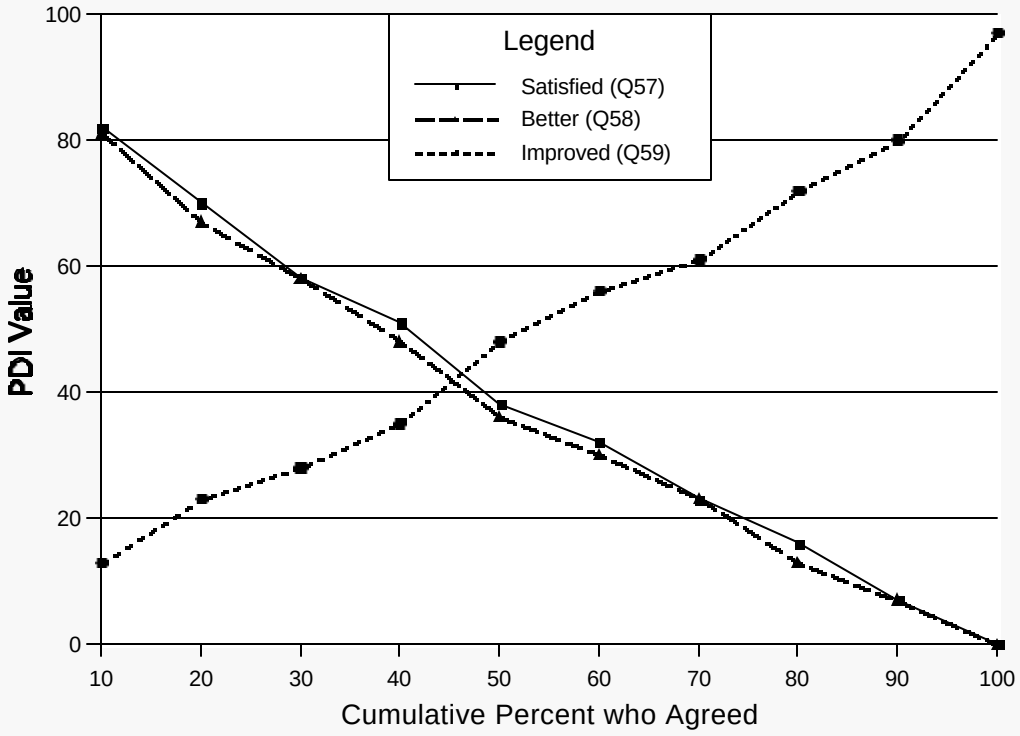
Figure 4.7:
At what PDI values did X% of respondents agree with the following three statements:

(All Flexible)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



Data are graphed for only flexible pavements and for only those respondents who agreed or strongly agreed with the above questions. Data correspond to Table 4.2.

of the pavement quality categories are applied to flexible pavements, a PDI of 59 (lower range of the "fair"category) would include approximately 30 percent of those who indicated "satisfied". A PDI of 40 (best of the "fair") would include approximately 48 percent of those who indicated "satisfied". A threshold PDI at the best of the "good" category (20) would account for approximately 75 percent of those "satisfied". A PDI of 23 would be needed to account for 70 percent of those indicating "satisfied". This is near the best quality boundary of the "good" category.

Rigid Pavements Only

For rigid pavements using data in the **thirteenth line** of **Table 4.2** or **Figure 4.8**, if the lower range of the "fair"category (PDI of 59) were used as a threshold, an estimated 11 percent of those who indicated "satisfied" would be included. A PDI of 40 (best of the "fair" category) would include an estimated 19 percent of those who indicated "satisfied". A PDI threshold at the best of the "good" category (20) would included an estimated 49 percent. A PDI of 0 would be needed to account for 70 percent of those in the "good" category. This is a perfect score assigned to a new pavement without any distress. Flexible and rigid pavements have different threshold values.

South Arterial Pavements Only

Because South arterial and South collector pavements had both statistically significant mean levels of satisfaction and they are practically different as well, separate analyses of threshold levels are developed. Using data from **Line one** of **Table 4.3** or **Figure 4.9**, if the lower boundary of the "fair" condition (PDI of 59) were used as a threshold, an estimated 18 percent of those who indicated "satisfied" would be included. If the best boundary of the "fair" were used (PDI of 40), an estimated 29 percent would be included. If the threshold were set at the best of the "good" category (PDI of 20), an estimated 62 percent would be included. If the DOT wanted to satisfy 70 percent a threshold PDI of approximately 3 would be required. This is a nearly perfect pavement in the "very good" category.

South Collector Pavements Only

For South Collectors only, using data from **Line four** of **Table 4.3** or **Figure 4.10**, if the lower boundary of the "fair" condition (PDI of 59) were used as a threshold, an estimated 21 percent of those who indicated "satisfied" would be included. If the best boundary of the "fair" were used (PDI of 40), approximately 42 percent would be included. If the threshold were set at the best of the "good" category (PDI of 20), an estimated 62 percent would be included. If the DOT wanted to satisfy 70 percent a threshold PDI of approximately 23 would be required. This is near the best boundary of the "good" category. Therefore, South Arterials and South Collectors have different thresholds.

Analysis Of "Should Be Improved" Data - PDI - (Q59)

The PDI data for those who agreed the pavement "should be improved" in Phase III are not as close to the Phase II results, as was also the case with IRI data. This was also due to sample differences. Again, the same assumptions about responses were made with the analysis of PDI as were described

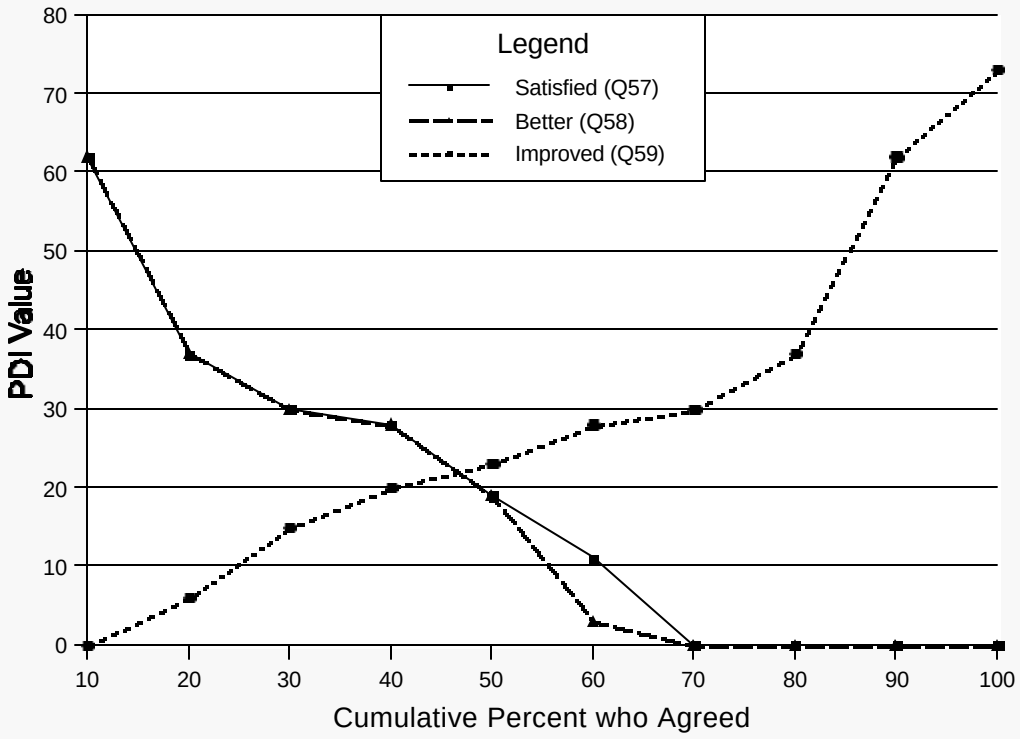
Figure 4.8:
At what PDI values did X% of respondents agree with the following three statements:

(All Rigid)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



Data are graphed for only rigid pavements and for only those respondents who agreed or strongly agreed with the above questions. Data correspond to Table 4.2.

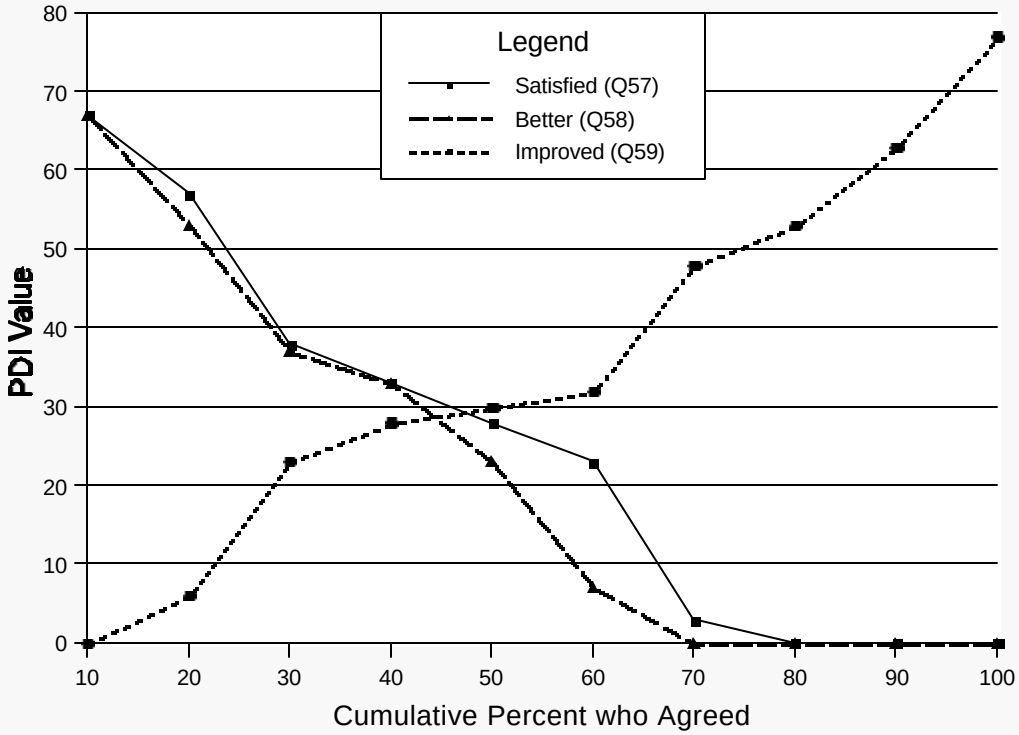
Figure 4.9:
At what PDI values did X% of respondents agree with the following three statements:

(All South Arterials)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



Data are graphed for only Southern Arterial pavements and for only those respondents who agreed or strongly agreed with the above questions. Data correspond to Table 4.3.

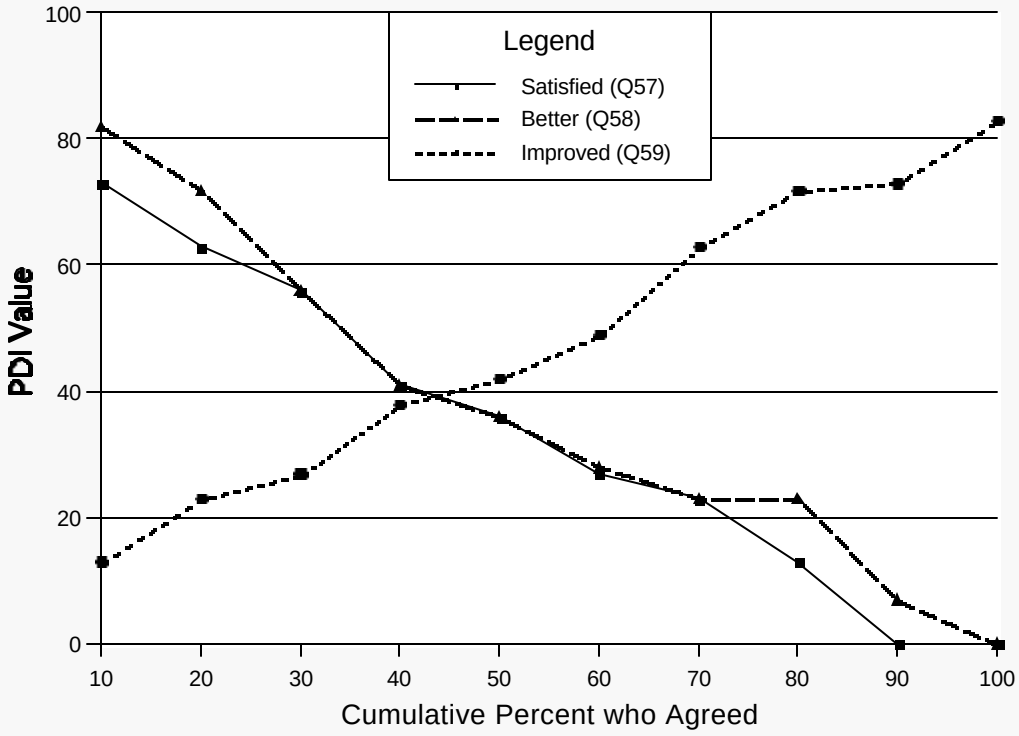
Figure 4.10:
At what PDI values did X% of respondents agree with the following three statements:

(All Southern Collectors)

"I am satisfied with the pavement on this section of highway"

"The pavement on this section of highway is better than most sections of state highways I've driven recently in Wisconsin"

"The pavement on this section of highway should be improved"



Data are graphed for only Southern Collector pavements and for only those respondents who agreed or strongly agreed with the above questions. Data correspond to Table 4.3.

in the section about IRI. Some thought pavements near the top of the "very good" range "should be improved", while the lower range for response was into the "very poor" category. The same groupings of region, pavement type and classification as analyzed under IRI are included in this section.

All Pavements

Using data from **line three**, **Table 4.2 or Figure 4.4**, if a threshold of 39 were set (lower range of the "good" category), an estimated 53 percent who agreed with "improve" would be included. If the lower range of the "fair" category (PDI of 59) were set as a threshold, approximately 70 percent would be included. This is the lower boundary of the "fair" category.

North Pavements Only

Using data from **line six**, **Table 4.2 or Figure 4.5**, if a threshold of 39 were set (lower range of the "good" category), an estimated 48 percent who agreed with "improve" would be included. If the lower range of the "fair" category (PDI of 59) were set as a threshold, an estimated 63 percent would be included. If the DOT wanted to include 70 percent of those who agreed with "improve", a threshold PDI of 61 would be required. This is near the best boundary of the "poor" category.

South Pavements Only

Using data from **line nine**, **Table 4.2 or Figure 4.6**, if a threshold of 39 were set (lower range of the "good" category), an estimated 58 percent who agreed with "improve" would be included. If the lower range of the "fair" category (PDI of 59) were set as a threshold, an estimated 77 percent would be included. If the DOT wanted to include 70 percent of those who agreed with "improve", a threshold PDI of 50 would be required. This is the midpoint of the "fair" category. There are threshold differences between North and South regions.

Flexible Pavements

Using data from **line twelve**, **Table 4.2** or **Figure 4.7**, if a threshold of 39 were set (lower range of the "good" category), an estimated 43 percent who agreed with "improve" would be included. If the lower range of the "fair" category (PDI of 59) were set as a threshold, an estimated 67 percent would be included. If the DOT wanted to include 70 percent of those who agreed with "improve", a threshold PDI of 61 would be required. This is near the best boundary of the "poor" category.

Rigid Pavements

Using data from **line fifteen**, **Table 4.2 or Figure 4.8**, if a threshold of 39 were set (lower range of the "good" category), an estimated 81 percent who agreed with "improve" would be included. If the lower range of the "fair" category (PDI of 59) were set as a threshold, an estimated 89 percent would be included. If the DOT wanted to include 70 percent of those who agreed with "improve", a threshold PDI of 30 would be required. This is near the midpoint of the "good" category. Although this is substantially different than the thresholds for flexible pavements, a review of **Tables I-1** and **2.1** shows how quality

scales change between IRI and PDI samples. The different thresholds for flexible and rigid pavements are partly due to sample differences. The sample was selected based on IRI and more rigid pavements of poorer quality were sampled as stated previously. If PDI sample distribution is reviewed (Table I-1) more rigid pavements of better quality were sampled. The sample for flexible pavements exhibited some but not as much disparity based on pavement index used. This is discussed under **Special Analyses** (**Objective 6**) and **Summary and Conclusions**.

South Arterial Pavements Only

Using data from **line three**, **Table 4.3 or Figure 4.9**, if a threshold of 39 were set (lower range of the "good" category), an estimated 64 percent who agreed with "improve" would be included. If the lower range of the "fair" category (PDI of 59) were set as a threshold, an estimated 87 percent would be included. If the DOT wanted to include 70 percent of those who agreed with "improve", a threshold PDI of 48 would be required. This is the near the midpoint of the "fair" category.

South Collector Pavements Only

Using data from **line six**, **Table 4.3 or Figure 4.10**, if a threshold of 39 were set (lower range of the "good" category), an estimated 44 percent who agreed with "improve" would be included. If the lower range of the "fair" category (PDI of 59) were set as a threshold, an estimated 67 percent would be included. If the DOT wanted to include 70 percent of those who agreed with "improve", a threshold PDI of 63 would be required. This is near the best boundary of the "poor" category. There are threshold differences between South Arterials and South Collectors.

Analysis of "Better Than Most" - PDI - (Q 58)

This question is not helpful in setting a threshold by itself, but when analyzed with responses to Q 57 and Q 59, might prove helpful. **Line two** of **Table 4.2** or **Figure 4.4** can be used for PDI on all pavements. If the same 70 percent level is applied to those who agreed with this question, a PDI of 19 would result. If the other groupings of pavements are considered for PDI as used under Q 57 and 59, the 70 percent thresholds for PDI (and their data source listings would be as follows:

- All North pavements (**Line five, Table 4.2, Figure 4.5**) PDI of 23
- All South pavements (**Line eight, Table 4.2, Figure 4.6**) PDI of 7
- All flexible pavements (**Line eleven, Table 4.2, Figure 4.7**) PDI of 23
- All rigid pavements (**Line fourteen, Table 4.2, Figure 4.8**) PDI of 0
- All South Arterials (**Line two, Table 4.3, Figure 4.9**) PDI of 0
- All South Collectors (**Line five, Table 4.3, Figure 4.10**) PDI of 23

Summary - Objective 4 thresholds

Table 4.4 shows in summary form where potential thresholds would lie aside the Wisconsin quality scales for IRI and PDI from **Table 1.2 and 1.3** respectively, if set at the level of 70 percent of the respondents in agreement with the three questions on satisfaction ("satisfied" marked **S**, "improve" marked **I**, and "better

Table 4.4 - Comparison of 70 percent Thresholds with Wisconsin DOT Quality Levels

IRI Scale	IRI -	IRI -	IRI -	PDI Scale	PDI -	PDI -	PDI -	PDI -	PDI -	PDI -	PDI -
WisDOT	All Pavts.	Flex.	Rigid	WisDOT	All Pavts.	All N	All S	Flex.	Rigid	S.Arter.	S. Collector
V.Good 0.7				**V.Good** 0					**0 S,B**	**0 B** **3 S**	
1				10			**7 S,B**				
1.2				15							
1.44				19	**19 B**						
Good 1.45				**Good** 20	**20 S**				**22 X**		
1.5				25		**23 S,B**		**23 S,B**			**23 S, B**
1.6				30			**30 X**		**30 I**	**30 X**	
1.7	**1.74 S,B**	**1.69 S,B**		35	**34 X**						
1.8				39							
Fair 1.81				**Fair** 40		**40 X**		**43 X**			**40 X**
2		**2.0 X**	**1.94 S**	46						**48 I**	
2.1			**2.05 B**	52			**50 I**				
2.25	**2.2 X**			59	**59 I**						
Poor 2.26 2.70			**2.6 X**	**Poor** 60 70		**61 I**		**61 I**			**63 S**
2.9	**2.76 I**	**2.64 I**		79							
V.Poor >2.90			**2.95 I**	**V.Poor** >80							

S = Q 57 "Satisfied" **B** = Q 58 "Better than Most" **I** = Q 59 "Improve"

X = Intersection of Cumulative Percent Plots, Q 57 ("Satisfied") and Q 59 ("Improve")

than most" marked **B**). These bold values of IRI and PDI come out of the analyses in Part 4. In addition, the intersection points of the cumulative response to Q 57 ("satisfied") and Q 59 ("improve") from **Figures 4.1** through **4.10** are marked at **X** in **Table 4.4,** near where they fall on the quality scale taken from **Tables 1.2 and 1.3**. The intersections of the cumulative percent responses on Q57 and Q59 on **Figures 4.1** and **4.4** for all pavements are slightly different than those in **Figures 3.1** and **3.2**. They are an IRI of approximately 2.2 at 42 percent and a PDI of approximately 34 at 48 percent. The difference between intersection points in the figures in Objective 3 and 4 is due to the skew of the samples. Similar intersection points are shown in **Figures 4.2, 4.3, and 4.5** through **4.10** and are marked **X** in **Table 4.4**. These intersection points (**X**) are applied later in the **Summary and Conclusions**.

One additional observation that can be made from the data illustrated in the above table is that the 70 percent thresholds for "S" & "B" are close to each other for both IRI and PDI. This also is shown graphically in **Figures 4.1 through 4.10**.

If a threshold were to be set recommended solely on physical data, the IRI data seem to correlate better with satisfaction data (**Table 3.3**). There are also fewer differences between regions, pavement types and classifications with the PDI thresholds. These differences, and whether there should be separate thresholds, will also be discussed in the **Summary and Conclusions**.

OBJECTIVE 5:
DEVELOPING AND TESTING OF "THE MODEL"--
EXPLORING THE PATH BETWEEN PAVEMENT CHARACTERISTICS AND DRIVER SATISFACTION USING THE "EXPECTANCY VALUE THEORY OF FISHBEIN AND AJZEN"

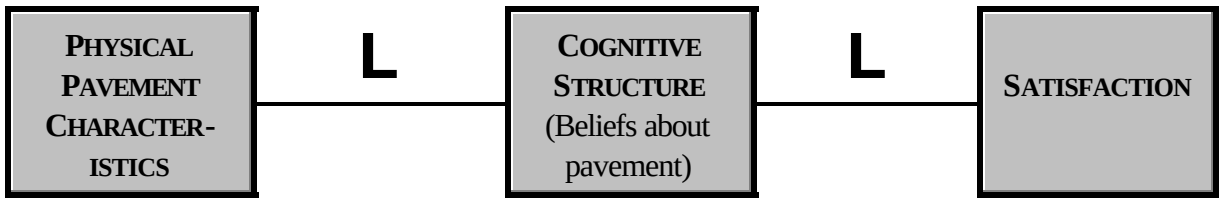
Introduction

The same psychological theory developed in Phase II was used to explain the relationship between physical pavement characteristics and driver satisfaction. **This model is based on Fishbein's and Ajzen's Expectancy Value theory of attitudes and on Ajzen Theory of Reasoned Action.** As applied, these two related models would propose, for example, that a person's attitude toward driving a stretch of pavement is based on a limited set of salient beliefs (usually 5 - 9 beliefs) about that particular stretch of highway. Each belief associates the behavior (i.e., driving) with a specific attribute or outcome. In general, people develop favorable attitudes when good outcomes are perceived as likely and bad outcomes are perceived as unlikely. People tend to develop bad attitudes when bad outcomes are perceived as likely and good outcomes unlikely.

The relevant beliefs are formed by prior experience, information gained from others, and by inferences a person draws from experience and information. The theory suggests that a motorist mentally weighs the set of beliefs to develop an overall attitude toward driving on a particular stretch of highway. The beliefs used in the analysis that follows were identified via focus groups in phase one of the study. Collectively, the beliefs are called "**cognitive structure**".

Figure 5.1 illustrates the hypothesized ordering of variables leading to driver satisfaction. The variables are 1) physical pavement characteristics, 2) cognitive structure as composed of salient beliefs about the act of driving on the pavement, and 3) attitude operationalized[1] as satisfaction with pavement characteristics. Knowing what motorists believe about the pavement will help policy makers determine what aspects of pavement quality are perceived by motorists and how those perceptions drive satisfaction with pavement quality.

Figure 5.1: Cognitive structure as intervening variable between physical pavement characteristics and satisfaction with pavement characteristics



[1] The term operationalized as used in the social sciences means "created as an operational definition."

Physical pavement characteristics - Physical pavement characteristics are operationalized as the IRI and PDI as described above. The measures are used separately in statistical analyses.

Model Development

Satisfaction - Satisfaction, as noted previously, is operationalized as the summation of the three "threshold" measures of satisfaction with pavement conditions. Question 59 (i.e. "The pavement on this stretch of highway should be improved") was reverse coded for this index.

Pavement beliefs and cognitive structure - The same five beliefs used in Phase II will be included in this analysis. The beliefs were originally ascertained via a subcontractor (the Wisconsin Survey Research Laboratory) who conducted a series of focus groups around the state. Analysis of focus group transcripts revealed the following five dimensions of belief which were then turned into Likert-type items in the questionnaire:

- "Driving on the pavement on this section of highway causes extra wear on my vehicle's suspension system" (Q32);
- "Driving on the pavement on this section of highway produces a bumpy ride" (Q34);
- "Driving on the pavement on this section of highway causes me to focus my attention on the pavement surface" (Q36);
- "Driving on the pavement on this section of highway is noisy" (Q38);
- "The pavement on this section of highway looks patchy" (Q40).

As with Phase II, the five measures were summed to produce a single, unidimensional scale of cognitive structure with a superb reliability (Cronbach's alpha of .89, see p.25). The Cronbach's alpha for the same scale in Phase II was nearly identical (.88), lending additional support to the measure's excellent reliability. Higher scores represent beliefs that the pavement is more problematic and of *lower* perceived quality along the dimensions noted. Therefore, cognitive structure should be positively related to IRI and PDI. Cognitive structure should also be negatively related to satisfaction.

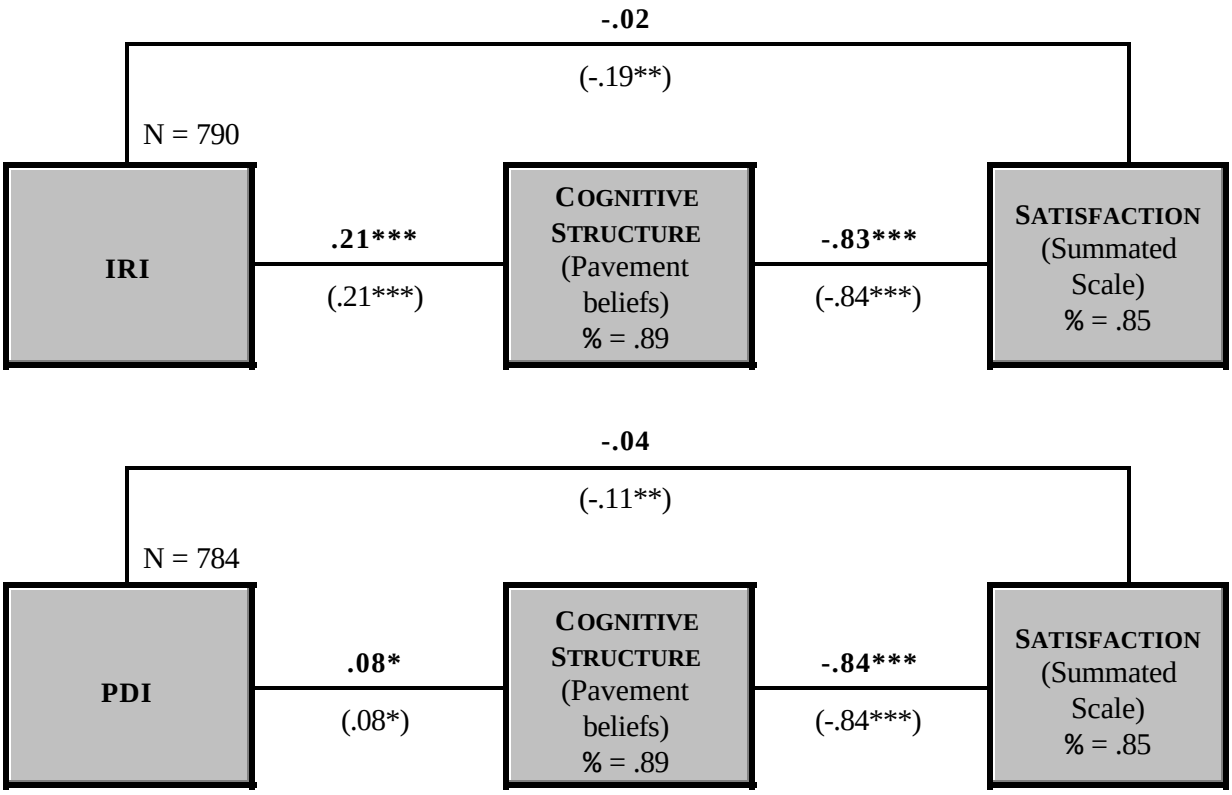
Cognitive structure as intervening variable - The path analyses illustrated in **Figure 5.2** indicate that cognitive structure does indeed mediate between pavement characteristics and satisfaction. Overall, the pattern of results essentially replicate those found in Phase II. As predicted the strength of the direct (unmediated) relationship between IRI and satisfaction is stronger in Phase III (-.19) than Phase II (-.15). The other relationships in the IRI model were also slightly stronger in Phase III than Phase II.

As with Phase II results, mediation is clearly suggested, because, for example, the statistically significant, zero-order (original) relationship between IRI and satisfaction (beta[1] = -.19, p #.01) diminishes to near zero (beta = -.02, non-significant) when cognitive structure is entered into the path analysis as an intervening variable. The relationship between IRI and cognitive structure remains significant, as does the inverse relationship between cognitive structure and satisfaction. The beliefs that comprise cognitive structure also seem to be reasonably comprehensive, at least to the extent that they intercept the beliefs that people can derive from the physical characteristics of the pavements as measured by IRI and PDI.

The strength of the relationships in **Figure 5.2** suggest that this a relatively concise model that works well. The relatively weak relationship between physical pavement indices and satisfaction seems indirect and (in these analyses) fully mediated by drivers' beliefs about the pavement. Together, cognitive structure and IRI (or PDI) account for about 72 percent of the variance in satisfaction. This illustrates the importance of the role of attitudes and beliefs play in driver satisfaction. However, even though the relationship between cognitive structure (CS) and satisfaction is remarkably strong, (beta= -.84, p# .001), there is still some variance in satisfaction (about 28%) not explained by cognitive structure and pavement characteristics. A more elaborate model will be used to try to account for the remaining 28 percent of variance in satisfaction. Of course, some unexplained variance is certainly error stemming from measurement error and sampling error, although the amount of measurement error in the cognitive structure and satisfaction indices is reasonably small, judging from their reliabilities.

[1] Beta is a coefficient like a correlation coefficient that can range from -1 to +1 and is the product of a regression analysis in which the measures are standardized (universal scale of -1 to +1). Whether a coefficient is + or - depends on the direction of the numeric scales on the two items being compared.

Figure 5.2: Path analysis —
Cognitive structure as intervening variable
between physical pavement characteristics and satisfaction
(zero-order beta) **Path Coefficient**



Two-tailed significance key: * p#.05 ** p# .01 *** p# .001

Other predictors - Expectancy Value Model

The full psychological model predicting satisfaction is illustrated in **Figure 5.3**. It is the same model used in Phase II of the project, with the following two exceptions. Income was dropped as a demographic variable and "Miles driven per year" was dropped as an experiential variable because they did not seem to have predictive utility in Phase II. The following variables were predicted to account for variance in satisfaction above and beyond IRI and cognitive structure.

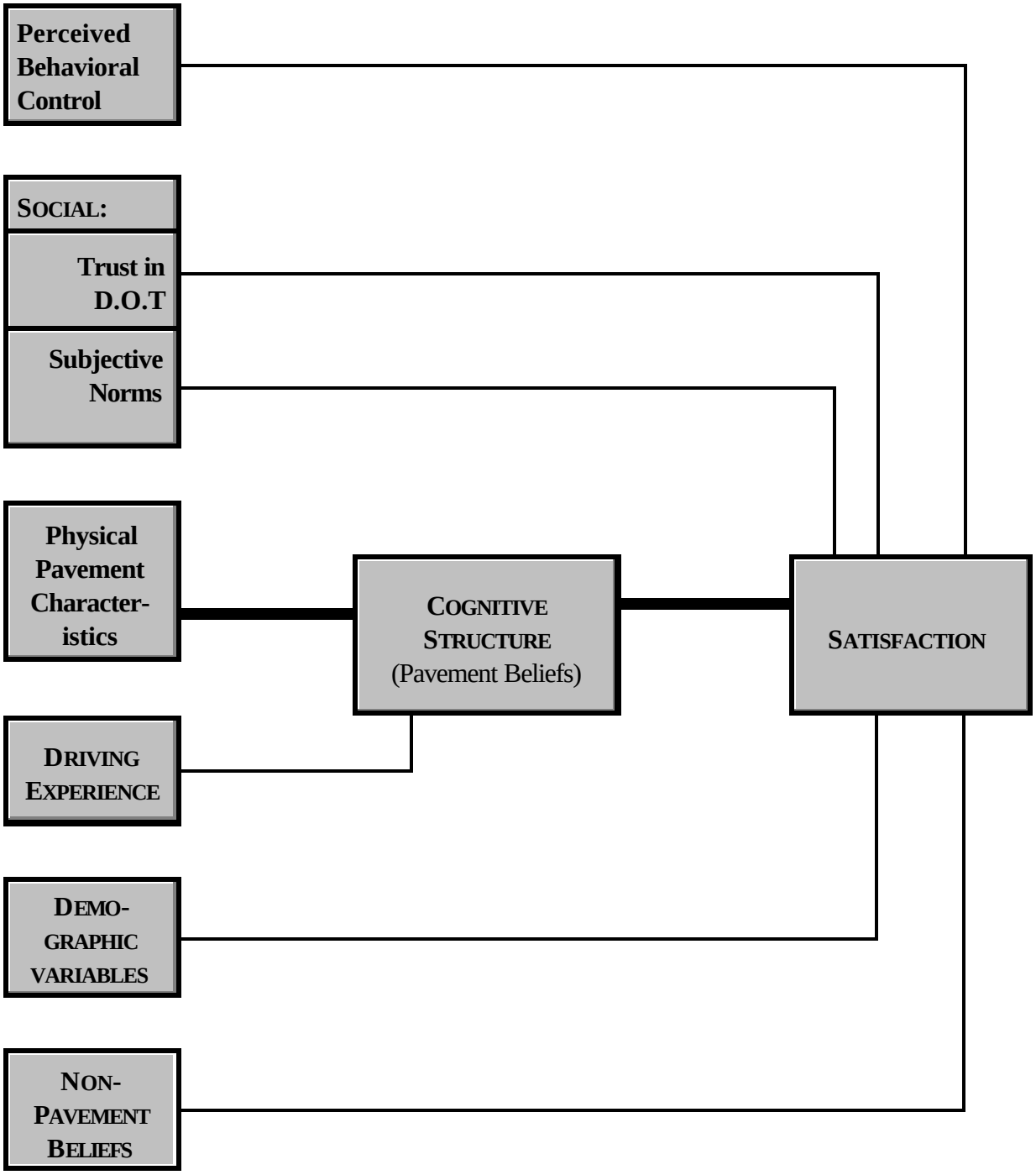
Perceived Behavioral Control (PBC). Adapted from **Ajzen's Theory of Planned Behavior**, we expected that perceived behavioral control could affect satisfaction. PBC reflects the amount of perceived control or voluntariness in a given behavior — in this case, driving along a given stretch of highway. Although PBC is usually a predictor of behavior, it was reasoned that motorists' responses to highway pavement conditions might be affected by whether or not they could choose an alternate route to travel. To measure PBC, responses were gathered on five-point, Likert-type scales to this item (Q55): "If I wanted to, I could easily find a convenient alternate route to the places I usually go instead of using this stretch of highway." Higher scores represent greater perceived control.

Social variables: Subjective norms and trust. Two variables reflecting social relationships — subjective norms and trust in the state Department of Transportation — might also affect satisfaction. Also adapted from Ajzen's model, subjective norms (SN) reflect felt social pressures, specifically, what a person believes others think he or she should do. In adapting this measure from being a predictor of behavior to a predictor of attitude (satisfaction), the wording became: "Most people whose opinions are important to me think that it is OK for me to drive this stretch of highway" (Q59a). It was reasoned that a person's own attitude could be affected by others who matter to him or her, especially if they express concern over the person's driving on a given stretch of road. Higher scores on this Likert-scaled item represent stronger agreement with the item.

Trust in the Department of Transportation might also affect satisfaction, at least by mitigating any anger that might be produced by driving along stretches of road with deteriorating pavement conditions. Trust was ascertained by summing respondent answers to four Likert-scaled items (Cronbach's alpha = .66):

- The state DOT is capable of doing a good job of fixing and replacing pavements on rural highways in Wisconsin" (Q51);
- "I trust the judgment of the state DOT when it comes to scheduling pavement improvements" (Q52);
- "State DOT officials care about the safety and convenience of drivers on this stretch of road" (Q53);
- "The DOT considers input from people like me when making decisions about repairs or improvements to this stretch of highway" (Q53a).

Figure 5.3:
Hypothesized predictors of satisfaction with pavement conditions



Driving experience. A person's driving experience can serve as a foundation for the development of his or her beliefs about pavement conditions. Three separate variables were used to reflect this experience: frequency of driving a motorcycle (derived from Q105b), the frequency of driving along the specific stretch of highway in question (Q28a), and the self-reported quality of ride of his or her vehicle (Q103). As mentioned above, the question measuring miles driven per year (Q104) was dropped from the Phase III survey.

Non-pavement beliefs. Results from Phase II confirmed the importance of considering non-pavement beliefs when attempting to understand driver satisfaction. Above and beyond pavement condition, beliefs people hold about the environment they experience when driving along a stretch of highway is significantly related to satisfaction. Responses were again gathered via Likert-type scales to indicate whether the motorists believed that the stretch of highway in question was very hilly (Q48), was very curvy (Q47), was scenic (Q46), had a high volume of traffic (Q44), had pavement marking lines that were clear and easy to see (Q45), and made one feel comfortable pulling on to the shoulder if necessary (Q43).

Analysis

Table 5.1 shows the results of the path analytic multiple regression analyses. The procedures used are similar to those followed in Phase II. In Phase II, three separate analyses were conducted, one with each pavement measure (i.e., PDI Flex, IRI, Rutting). Here, only IRI was used. First, cognitive structure was first regressed on the various blocks of predictor variables. Then satisfaction was regressed on the same blocks plus cognitive structure. The results will (1) test the relationships illustrated in Figure 5.3 and (2) show how the relationships among physical characteristics of the pavement, cognitive structure, and satisfaction illustrated in **Figures 5.2 and 5.3** may be affected by the other variables. Hierarchical multiple regression was used, with blocks of variables entered in the following order: **(1)** Demographic control variables — education (Q108), sex (Q998b), and age (from Q100); **(2)** the set of experiential variables; **(3)** the set of social variables; **(4)** perceived behavioral control; **(5)** the set of non-pavement beliefs; **(6)** the physical pavement measure; and **(7)** cognitive structure (for the regression of satisfaction only).

Results confirm what was found in Phase II. The **physical measures $ cognitive structure $ satisfaction** relationships from **Figure 5.2** remain in effect (albeit reduced in magnitude) even with controls for these sets of variables. For example, when looking at the **Table 5.1** analysis using IRI as the pavement index, the path from IRI to cognitive structure is .16 (p#.001), from cognitive structure to satisfaction -.79 (p#.001), and from IRI to satisfaction -.02 (p#non-significant). In summary, cognitive structure significantly reduces (i.e., mediates) the relationship between physical pavement characteristics and satisfaction. Thus, the basic model holds, even with rigorous controls. These results strongly replicate the findings in Phase II. Overall, the set of predictor variables account for up to 22 percent of the variance (see adjusted R^2 in Table 5.1) in cognitive structure and 73 percent of the variance in satisfaction.

Table 5.1: Relationship of control variables and IRI to cognitive structure and satisfaction with pavement conditions (full model)

Multiple regression analyses (betas)

	All Pavements		*Flexible Only*		*Rigid Only*	
DEPENDENT VARIABLE:	**Cognitive Structure ℅ = .89[1]**	**Satis-faction ℅ = .85**	**Cognitive Structure**	**Satis-faction**	**Cognitive Structure**	**Satis-faction**
DEMOGRAPHIC:						
Education	-.03	-.02	-.01	-.01	.00	-.07
Female Sex	-.01	-.01	-.05	-.00	.04	-.05
Age	-.02	-.01	-.03	-.02	-.00	-.00
R^2 change	.00	.00	.00	.00	.00	.01
EXPERIENTIAL:						
Cycle driving frequency	.05	-.03	.09	-.04	-.04	.01
Vehicle "ride"	.07	-.04	.05	-.03	.12	-.08
Frequency of driving stretch	.02	-.02	.04	-.03	-.03	.02
R^2 change	.01	.00	.01	.00	.02	.01
SOCIAL:						
Trust in transportation dept. ℅=.66	-.05	**.14*** **	-.04	**.11*** **	-.09	**.20*** **
Subjective norms	**-.35*** **	**.35*** **	**-.38*** **	**.40*** **	**-.29*** **	**.27*** **
R^2 change	**.13*** **	**.17*** **	**.15*** **	**.19*** **	**.10*** **	**.13*** **
PERCEIVED BEHAVIORAL CONTROL	-.01	.05	-.01	.06	.01	.02
R^2 change	.00	.00	.00	.00	.00	.00
NON-PAVEMENT BELIEFS						
Very hilly	**.08** **	-.06	.08	-.05	.11	-.12
Very curvy	.01	.05	.00	.06	.04	.04
Scenic	-.01	.00	-.02	.00	-.04	.04
High traffic volume	**.15*** **	**-.11*** **	**.14*** **	**-.10** **	**.16*** **	**-.17** **
Comfortable shoulders	**-.08** *	**.15*** **	-.07	**.14*** **	**-.19** **	**.19** **
Clear pavement markings	**-.18*** **	**.17*** **	**-.25*** **	**.22*** **	.03	.03
R^2 change	**.07*** **	**.07*** **	**.09*** **	**.08*** **	**.08*** **	**.07*** **
INTERNATIONAL ROUGHNESS INDEX (IRI)	**.16*** **	-.02	**.10** **	.01	**.34*** **	-.03
R^2 change	**.02*** **	.01	**.01** **	.01	**.10*** **	.01
COGNITIVE STRUCTURE		**-.79*** **		**-.77*** **		**-.79*** **
R^2 change		**.47*** **		**.44*** **		**.44*** **
Multiple R	**.49*** **	**.86*** **	**.52*** **	**.85*** **	**.55*** **	**.88*** **
Adjusted R^2	.22	.73	.25	.72	.24	.76
	790	790	583	583	207	207

Two-tailed significance key: * p#.05 **p#.01 ***p#.001

[1]. Cronbach's alpha (℅) is a standard measure of instrument reliability. It is explained on p. 25

To streamline the analysis, forward step-wise regression was performed to maintain R^2 while limiting the number of variables in the analysis. The results in **Table 5.2** indicate (on a preliminary level) the variables that should be retained by the Wisconsin DOT for the creation of a survey form to assess driver satisfaction in the future. This recommendation should be considered preliminary and may change depending on subsequent analyses from Minnesota and/or Iowa samples. **In addition to measures of cognitive structure and satisfaction, trust in D.O.T., subjective norms, and four of the six non-pavement beliefs are retained**. When all of these variables are considered, 28 percent of the variance in cognitive structure and 73 percent of the variance in satisfaction is accounted for by the equations. (By comparison, IRI alone accounts for about 4 percent of the variance in satisfaction — see R^2 *change* for PDI). For this reason, it is important to include psychological measures, such as beliefs and trust to supplement physical pavement measures.

The paths of relationships from the analysis using all pavement types is illustrated in **Figure 5.4** and can be compared to the hypothesized relationships in Figure 5.3. As noted previously, the path from IRI to cognitive structure to satisfaction remains intact, with cognitive structure being by far the best predictor of satisfaction. Higher IRI ratings seem to produce stronger beliefs about pavement problems on the stretch of highway (beta = .16, p#.001) and, in turn, these beliefs seem to yield less satisfaction with the pavement (beta = -.78, p# .001)[1].

Perceived behavioral control was not related to satisfaction or cognitive structure. As hypothesized, those with higher levels of trust in D.O.T. are more satisfied with the pavement (beta = .11, p#.001), as are those who believe that relevant others feel it is okay for them to drive that stretch of road (subjective norms beta = .35, p#.001). However, subjective norms also had an unexpected, significant relationship with cognitive structure. Specifically, those who believe that relevant others think it is not okay for them to drive that stretch are more likely to believe that the pavement has problems (beta = -.36, p# .001). This finding, however, does not seem to be spurious, as it was also found in the other states. Thus, subjective norms seems to affect what people perceive or believe (cognition, as indicated by cognitive structure) as well as how they feel about it (affect, as indicated by satisfaction).

Four of the six non-pavement beliefs were related to cognitive structure and three of the six beliefs were related to satisfaction. In general, the variables seem to behave in a manner consistent with the model.

[1] Betas are explained on page 52. Since Cognitive Structure (pavement beliefs) can be considered as undesirable by most, and some non-pavement beliefs can be considered desirable (clear pavement markings) and some undesirable (high traffic volumes) this may help explain the + or - in front of a beta in Table 5.2. So the sign for the beta for clear pavement markings and cognitive structure is a - and for clear pavement markings and satisfaction is a +.

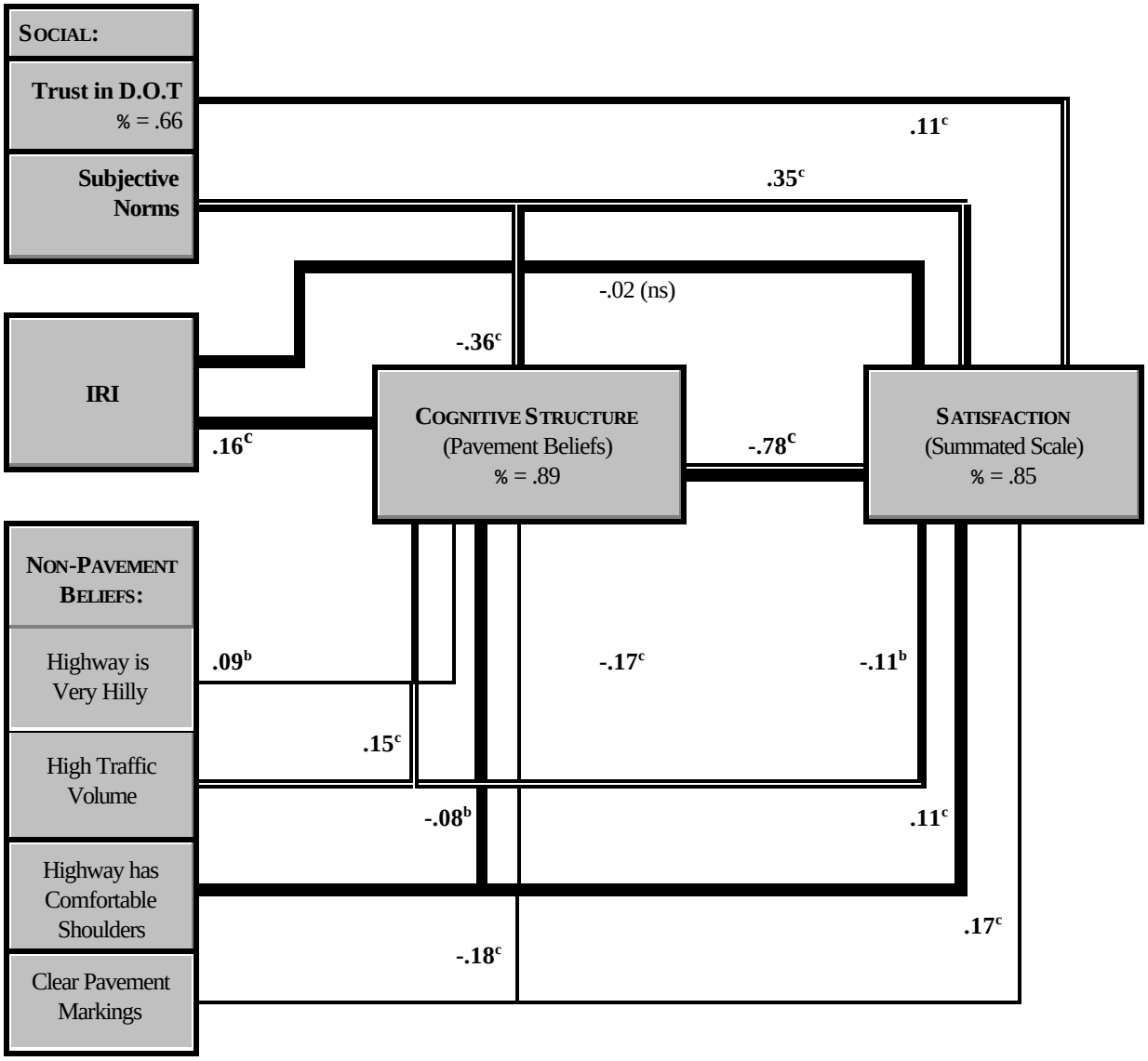
Table 5.2: Relationship of control variables and IRI to cognitive structure and satisfaction with pavement conditions (focused model)

Multiple regression analyses (betas)

	All Pavements		*Flexible Only*		*Rigid Only*	
DEPENDENT VARIABLE:	**Cognitive Structure ⍴ = .89**	**Satis-faction ⍴ = .85**	**Cognitive Structure**	**Satis-faction**	**Cognitive Structure**	**Satis-faction**
SOCIAL:						
Trust in transportation dept. ⍴=.66	-.06	**.11*** **	-.04	**.18** **	-.04	**.18*** **
Subjective norms	**-.36*** **	**.35*** **	**-.38*** **	**.39*** **	**-.38*** **	**.39*** **
R^2 change	**.14*** **	**.17*** **	**.15*** **	**.19*** **	**.15*** **	**.19*** **
NON-PAVEMENT BELIEFS						
Very Hilly	**.09** **	-.05	**.08***	-.03	**.08***	-.03
High traffic volume	**.15*** **	**-.11** **	**.14*** **	**-.10** **	**.14*** **	**-.10** **
Comfortable shoulders	**-.08** **	**.11*** **	**-.07***	**.14*** **	**-.06**	**.14*** **
Clear pavement markings	**-.18*** **	**.17*** **	**-.24*** **	**.21*** **	**-.24*** **	**.21*** **
R^2 change	**.07*** **	**.07*** **	**.09*** **	**.08*** **	**.09*** **	**.08*** **
PAVEMENT CONDITION INDEX (IRI)	**.16*** **	-.02	**.09** **	-.01	**.09** **	-.01
R^2 change	**.02*** **	**.00**	**.01** **	**.00**	**.01***	**.00**
COGNITIVE STRUCTURE		**-.78*** **		**-.77*** **		**-.77*** **
R^2 change		**.47*** **		**.44*** **		**.44*** **
Multiple R	**.49*** **	**.85*** **	**.50*** **	**.84*** **	**.48*** **	**.85*** **
Adjusted R^2	.22	.72	.24	.71	.21	.71
N	790	790	583	583	207	207

Two-tailed significance key: * p#.05 **p#.01 ***p#.001

Figure 5.4: Partial path analysis —
Predictors of satisfaction with pavement conditions
based on focused model, using IRI, all pavements
Path Coefficients



Two-tailed significance key: **a** = p # .05 **b**= p # .01 **c**= p # .001

Note: Bold lines are not more important than other less bold

Microscopic Analysis of Select Relationships

To diagnose the dynamics of the relationships in the **physical measures $ cognitive structure $ satisfaction** chain, we conducted analyses of the relationships among the individual items that comprise the cognitive structure and satisfaction indexes.

Partial correlation coefficients in **Table 5.3** indicate that overall (dis)satisfaction appears to be most affected by beliefs that the pavement causes extra wear on a vehicle's suspension (partial r= -.67, p#.001) and produces a bumpy ride (partial r= -.67, p#.001). Other important beliefs include that the pavement is noisy (partial r= -.60, p#.001) and looks patchy (partial r= -.53, p#.001). Consistent with Phase II results, beliefs about diversion of attention to the road surface play important but somewhat less, but still significant, role in overall satisfaction. Overall, the magnitude of these relationships increased from Phase II to Phase III.

A microscopic analysis of the relationships between both physical pavement measurements and pavement beliefs (components of cognitive structure) is shown in **Table 5.4.** Each pavement indices (IRI and PDI) were significantly related to each of the five beliefs that comprise cognitive structure, even after controlling for several control variables. Cognitive structure was most highly related with IRI (partial r= .18, p#.001) and to a lesser extent PDI (partial r= .07, p#.001). The size of this difference between these partial correlations is slight to moderate. IRI seems to be more highly related to the beliefs drivers hold about the pavement (beliefs that form the basis of driver satisfaction). It would appear to be a better measure for this type of modeling.

Table 5.3: Relationship of pavement beliefs to satisfaction

Partial correlation coefficients [1]

	Satisfaction Measure [2]:			
	Satisfied with pavement (item)	**Better than most (item)**	**Should be improved (item)**	**Satisfaction (summated)** [3] % = .80
PAVEMENT BELIEFS [2]				
Driving on the pavement on this section of highway....				
...Causes extra wear on my vehicle's suspension system.	-.67***	-.49***	.67***	-.72***
...Produces a bumpy ride.	-.67***	-.50***	.71***	-.74***
...Causes me to focus my attention on the pavement surface.	-.49***	-.36***	.48***	-.52***
...Is noisy.	-.60***	-.49***	.60***	-.66***
The pavement looks patchy.	-.53***	-.44***	.62***	-.62***
COGNITIVE STRUCTURE (summated pavement beliefs) % = .89	-.73***	-.56***	.76***	-.80***
N = 690				

Two-tailed significance key: * p#.05 **p#.01 ***p#.001

1. Fifteenth-order partials controlled by education, sex, age, cycle driving frequency, vehicle "ride," frequency of driving stretch of highway, trust in transportation department, subjective norms, perceived behavioral control, and the set of six non-pavement beliefs. *Not controlled by physical pavement characteristics.*

2. Beliefs and satisfaction items are scaled such that greater agreement produces higher numerical values.

3. Scoring of the item "the pavement...should be improved" was reversed in the calculation of the summated index.

Table 5.4: Relationship of pavement beliefs to physical pavement measures

Partial correlation coefficients [1]

	Physical Pavement Measure:	
	IRI	***PDI***
PAVEMENT BELIEFS [2]		
Driving on the pavement on this section of highway....		
...Causes extra wear on my vehicle's suspension system.	**.14*** **	**.05**
...Produces a bumpy ride.	**.18*** **	**.07***
...Causes me to focus my attention on the pavement surface.	**.13*** **	**.06***
...Is noisy.	**.16** **	**.04**
The pavement looks patchy.	**.11*** **	**.07***
COGNITIVE STRUCTURE (summated pavement beliefs) % = .89	**.18*** **	**.07***
N=	790	784

Two-tailed significance key: * p#.05 **p#.01 ***p#.001

1. Fifteenth-order partials controlled by education, sex, age, cycle driving frequency, vehicle "ride," frequency of driving stretch of highway, trust in transportation department, subjective norms, perceived behavioral control, and the set of six non-pavement beliefs.

2. Beliefs are scaled such that greater agreement produces higher numerical values.

Model Summary.

As predicted, the strength of the correlation between IRI and satisfaction was greater in Phase III (.19, **Table 3.3**) than in Phase 2 (.13, Table 2.3, Phase II report, May 5, 1999), albeit not greatly so. In general, analysis of the Phase III Wisconsin data confirm the robustness of the model. This is especially true of the core relationships among physical data, cognitive structure, and satisfaction. Additionally, these findings have been largely replicated in the analyses of the Minnesota and Iowa data. The model continues to work well not only as an explainer of satisfaction with pavements but also as a diagnostic tool. The relationships between physical data and cognitive structure continue to be impressive and consistent with expectations. The model illustrates that variables such as:

1) trust in the DOT,

2) subjective norms,

3) beliefs about the pavement and

4) beliefs about non-pavement characteristics

are important considerations when attempting to understand driver satisfaction.

OBJECTIVE 6 - SPECIAL ANALYSIS OF SELECTED RELATIONSHIPS

To gain additional insights into the responses of this sample of Wisconsin drivers, relationships among responses to selected items were analyzed.

Reasons for Improvement

Those Who Answered "Satisfied" and "Improve"

The first set of relationships of interest involved the respondents who answered "strongly agree" (SA) or "somewhat agree" (A) to both question 57 on satisfaction with their section of pavement and to question 59 stating that pavement on their section should be improved. A special sort was performed and the results shown in **Table 6.1** for 138 who agreed with both questions and their responses on the possible reasons for improvement. They were instructed to answer yes or no to all six possibilities and could answer yes on more than one. The percentages represent the proportion of the 138 who answered yes or no to any of the possible reasons for improvement.

Table 6.1
Breakdown of Those who SA or A with Both Q 57 and 59 by Response to Q 59a

	Yes	**No**
Q59a_1 The pavement causes extra wear on my vehicle's suspension.	**33%** 46	**67%** 92
Q59a_2 It produces a bumpy ride	**60%** 83	**40%** 55
Q59a_3 It causes me to focus my attention on the pavement surface.	**32%** 44	**68%** 94
Q59a_4 The Pavement is noisy	**36%** 49	**64%** 89
Q59a_5 It looks patchy.	**54%** 74	**46%** 64
Q59a_6 Because of a non-pavement reason?	**33%** 45	**67%** 93
Total agreeing with both Q57 and Q59	138	

The largest group (89 of 138) gave only pavement reasons for improvement in their responses. A further breakdown of these is shown in **Table 6.2**.

Table 6.2
Breakout of those who Agreed with Both Q 57 (satisfied) and Q 59 (improve) and gave only Pavement Reasons

	Yes	No	Total
Q59a_1 The pavement causes extra wear on my vehicle's suspension.	**39%** 35	**61%** 54	89
Q59a_2 It produces a bumpy ride	**72%** 64	**28%** 25	89
Q59a_3 It causes me to focus my attention on the pavement surface.	**37%** 33	**63%** 56	89
Q59a_4 The Pavement is noisy	**45%** 40	**55%** 49	89
Q59a_5 It looks patchy.	**62%** 55	**38%** 34	89
Q59a_6 Because of a non-pavement reason?	**0%** 0	**100%** 89	89

Although not shown in tabular form, another 26 of 138 gave both pavement and non-pavement reasons for agreeing with improvement and only 19 of the 138 gave only non-pavement reasons for agreeing with improvement. In addition, 4 of the 138 agreed with both questions but agreed with non of the pavement or non-pavement reasons. This does not really help explain why 138 agreed with both questions (Q57 and Q59), but it does indicate that non-pavement reasons can be a part of the reason for improvement in the eyes of the public. All who gave non-pavement reasons for improvement are explored below.

All Those with Non-pavement reasons for "Improve"

Table 6.3 summarizes all 122 individuals who agreed with Q 59 and answered "yes" to Q 59a 6) (non-pavement reason for improvement) and their non-pavement belief (Q 43-48) responses. This was done to see if there was any obvious single reason for their response. Two (Q 43 and 44) stand out, with 71 percent disagreeing with "I would be comfortable pulling onto the shoulder on this section," and 73 percent agreeing with "lots of traffic." The special analyses is useful to show non-pavement beliefs can be an important part of the improvement process. The 122 who expressed non-pavement beliefs represent

Table 6.3
Breakdown of Non-Pavement Beliefs for all those who Answered "Yes" to Q59a 6) as a Reason for Improve

	Strongly Disagree	**Somewhat Disagree**
Question 43 I would be comfortable pulling on to the shoulder on this section?	**53%** 65	**18%** 22
Question 45 The lines on this section are clear and easy to see.	**14%** 17	**16%** 19
Question 46 The scenery on this section is attractive.	**7%** 8	**9%** 11
	Strongly Agree	**Somewhat Agree**
Question 44 There is a lot of traffic on this section	**53%** 65	**20%** 24
Question 47 This section is very curvy.	**29%** 35	**16%** 19
Question 48 This section is very hilly.	**24%** 29	**24%** 29
Totals	**122**	

Approximately 32 percent (122 of 383 in **Table 1.1**) respondents who thought the specific highway segment they drove should be improved.

Correlation of Pavement Beliefs with Reasons for Improvement

Correlation analyses were performed to compare relative agreement with the pavement reasons for improvement listed in Q 59a 1) through 5 with the same respondents relative agreement with the list of pavement beliefs (Q 32 through 40) which used similar wording (pavement is bumpy etc.)for the two questions. **Table 6.4** shows those correlations which would indicate how closely each respondent's replies coincided (by their ranking on the Likert scale (SA, A etc). This diagnostic (correlation analysis) merely provided a consistency check between the pavement beliefs and the directly corresponding (pavement belief) responses to Q59a for those who agreed with the need to improve. Correlations for each corresponding pair were computed. The process yielded correlation coefficients of approximately 0.4 for

all relevant corresponding items. As such, there was relatively low response consistency.

Table 6.4
Correlation of Pavement Beliefs and Pavement Reasons for Improvement

	Correlation
Q32 & Q59a_1	0.408
Q34 & Q59a_2	0.398
Q36 & Q59a_3	0.366
Q38 & Q59a_4	0.398
Q40 & Q59a_5	0.356

Pavement Beliefs

Pavement Beliefs by Pavement Types.

This comparison involved respondents who agreed with one or more of the pavement beliefs (Q 32 through 40). The breakdown of responses by pavement type is shown in **Table 6.5**. Although the table information would lead to conclusions that driving on Flexible Pavements was more likely to give rise to pavement beliefs about wear on suspension, focusing attention and patches (approximately 72-74 %) it should be recalled (from **Table 2.1**) that 74 percent (584/790) of the drivers drove on Flexible Pavements so this is not unusual. However, for bumpy ride, the percentage for Rigid Pavements was disproportionate (40 % for the belief on 26 % of the pavements). Likewise, for the noisy pavement belief, the responses were slightly disproportionate (31 % of the belief on 26 % of the pavements). However, the sample was skewed toward those rigid pavements with a poorer ride (**Table I-1**) and this could affect response on both questions. Also, as noted in Part 4, motorists were more tolerant of a poorer ride on Rigid Pavements than on Flexible Pavements. So this analyses of pavement beliefs did not yield any significant added conclusions, except that pavement beliefs weren't changed substantially by the pavement type driven upon.

Table 6.5
Pavement Beliefs (Strongly Agree and Agree) by Pavement Types

	Flex	Rigid	Total
Question 32 Driving on the PAVEMENT on this section causes extra wear on my vehicle's suspension system.	**72%** 183	**28%** 70	253
Question 34 Driving on the PAVEMENT on this section produces a bumpy ride.	**60%** 159	**40%** 106	263
Question 36 Driving on the PAVEMENT causes me to focus my attention on the pavement surface.	**73%** 179	**27%** 67	246
Question 38 Driving on the PAVEMENT on this section is noisy.	**69%** 195	**31%** 89	284
Question 40 The pavement on this section looks 'patchy'.	**74%** 258	**26%** 89	347

Select Pavement Beliefs and Quality of Vehicle Ride

A question (103) was included at the end of the survey asking drivers to judge the quality of their ride. It was thought this might affect either their pavement beliefs or their perceptions of whether the pavement needed improvement. Correlation analysis (bi-variate) was run between all responses to Questions 32 (wear on vehicle suspension), 34 (bumpy ride) and 36 (focus attention)and the self-judgement of vehicle ride quality (hereafter called "ride quality"). Correlations are low (below - 0.11). Correlation of all responses to Q 59 (needs improvement) and ride quality (Q 103) is also low (0.12).

Agreement with select questions on pavement beliefs (Q 32, 34, and 36) and "needs improvement" (Q59) were categorized by ride quality and are shown in **Table 6.6** (percentages are rounded).

Table 6.6
Agreement with Select Pavement Beliefs and with "Improve" By "Ride Quality"

	VG	G	F	P	VP	Total
Q 32 (SA, A) Driving on the pavement on this section causes extra wear on my vehicle's suspension system.	**32%** 82	**36%** 89	**25%** 62	**6%** 16	**2%** 4	**100%** 253
Q 34 (SA, A) Driving on the pavement on this section produces a bumpy ride.	**33%** 120	**37%** 136	**24%** 87	**5%** 18	**1%** 4	**100%** 365
Q 36 (SA, A) Driving on the pavement on this section causes me to focus my attention on the pavement surface	**32%** 79	**33%** 80	**27%** 66	**6%** 16	**2%** 5	**100%** 246
Q 59 (SA, A) The pavement on this section should be improved	**36%** 138	**34%** 130	**24%** 93	**5%** 18	**1%** 4	**100%** 383

Phase II vs. Phase III Trust and Satisfaction Responses

One of the key actions in reviewing both Phase II and Phase III results is to compare the survey responses for the trust and satisfaction questions, which were central to much of this part of the analysis. It should be noted, of course, that the two surveys involved completely different samples of Wisconsin drivers. Phase II was a random sample of drivers, and Phase III was a select sample of households and their drivers who lived in proximity to a specific segment to be surveyed.

With regard to the trust items, Phase III exhibited increases in the percentages of respondents who strongly agreed or somewhat agreed with the statements in the questions. For question 51, the Wisconsin DOT's capacity of doing a good job of pavement repair, agreement [Strongly Agree (SA) and Somewhat Agree (SWA)] was slightly higher in Phase III that in Phase II, 86.5 percent vs. 83.1 percent respectively. As to WisDOT's judgement in scheduling pavement improvements, Q53, agreement rose considerably from 60.9 percent in Phase II to 72.3percent in Phase III. With reference to Q53, regarding WisDOT caring about drivers' safety and convenience, positive response increased somewhat from 74.9 percent in Phase II to 80 percent in Phase III. Finally, for Q53a, whether WisDOT considers input from Wisconsin divers, agreement was substantially greater in Phase III, namely 62.9 percent, than in Phase II, which yielded 43 percent. Overall, the findings verify the results of Phase II and indicate there is a high degree of trust in WisDOT.

Survey responses to questions 57 through 59 revealed lower satisfaction in Phase III in terms of comparisons. Overall satisfaction with the selected pavement sections throughout Wisconsin (Q57) was somewhat lower in Phase III, namely, 67.3percent vs. 80percent in Phase II. Agreement that the respondent's pavement section should be improved (Q59) rose from 32percent in Phase II to 45.8percent in Phase III. Finally, for Q58, agreement that the pavement on the respondent's section was better than most other sections in Wisconsin declined from 54.7percent in Phase II to 48.5percent in Phase III. Again, it must be emphasized that these are two different samples of Wisconsin drivers and designated (Phase III) versus self-selected pavement stretches. The Phase III stratified sample included more pavement segments in the "poor" to "very poor" quality categories, so the responses were consistent with that.

Trust Question Crosstab Analysis

The trust of the Phase III survey highlighted above comprised questions 51 through 53a. Analysis encompassed cross-tabulating these four questions against the following groups of other survey questions: **1**) driving frequency, questions 28; **2**) pavement belief questions 32-40; **3**) non-pavement questions 42.48; **4**) satisfaction questions 57-59; **5**) vehicle type questions 101-103; **6**) demographic questions; age Q100, education A108, gender Q998b; and **7**) license, Q105-Q105b.

It is expedient at this point to identify the specific nature of the statistical analysis conducted on the survey data. The chi-square test of independence was employed to determine whether relationships between cross tabulated variables were significant at the 95 percent confidence level. Since the data were predominately ordinal in nature, the appropriate test is the Spearman Correlation Coefficient, which has been applied throughout the analysis. This test measures the extent of the relationships between two response sets. In

that the term "crosstab" will be used repeatedly in subsequent report sections, it has been abbreviated to "Xtab."

Trust vs. Satisfaction

Intuitively, one might well expect trust in WisDOT to be related to satisfaction with the pavement on which respondents were driving. Analysis by means of cross-tabulating the four trust questions against the three satisfaction questions confirmed statistically-significant relationships across all Xtabs. The results are discussed below and summarized in **Table 6.7** which follows the complete discussion.

Q51 (WisDOT capable of fixing and replacing pavements)

For the first of the four trust questions, Xtab analysis yielded two statistically-significant relationships, involving satisfaction questions 57 and 59. Respondents who were very satisfied with the pavement (Q57) were considerably more likely to strongly agree that WisDOT is capable than were those who were very dissatisfied [Very Satisfied (VS) 50percent vs. Very Dissatisfied (VD) 13.8percent]. At the same time, selection of "strongly agree" on this trust item was made by over half (53.2percent) of the motorists who strongly disagree that their pavement section should be improved.

Q52 (Trusting WisDOT's judgement in scheduling improvements)

All three satisfaction questions were significantly related to this particular trust question. First, strong agreement with this trust item was substantially more likely for drivers who were very satisfied with the pavement (Q57) than for those who were very dissatisfied (VS 55.4 % vs. VD 15.8 %]. Likewise, choice of "strongly greed" with trusting WisDOT's judgement was made somewhat more often by motorists who strongly agreed that their pavement section was better than most others in Wisconsin (Q58) than by those who strongly disagreed. Finally, 40.5 percent of the respondents who strongly disagreed that their pavement section should be improved, in turn, strongly agreed with this trust item. As such, the findings were consistent.

Q53 (WisDOT cares about safety and convenience of drivers on this stretch)

Once again, there were significant relationships for all three satisfaction questions. Drivers who were very satisfied with the pavement (Q57) were much more likely to strongly agree that WisDOT cares than were those who wee very dissatisfied [VS 57.9% vs. VD 10.5%]. Strong agreement with this trust item, moreover, was somewhat more frequent for motorists who strongly agreed that their pavement section was better than most others (Q58) than for those who strongly disagreed. At the same time, selection of "strongly agree" that WisDOT cares was made more often by respondents who strongly disagreed that their pavement section should be improved (Q59) than by those who strongly agreed [SD 34.2% vs. SA 16.8%]. As with the previous trust item, there was consistency across the results.

Q53a (WisDOT considers input from people like me when making decisions on improvement to this stretch)

As with trust question 51, only two satisfaction questions were significantly associated with 53a. Motorists who were very satisfied with the pavement (Q57) were substantially more likely to strongly agree that

WisDOT heeds drivers' input than were those who were very dissatisfied [VS 52.7% vs. VD 16.5%]. At the same time, strong agreement that WisDOT considers input was more frequent for respondents who strongly agreed that their pavement section was better than most others in Wisconsin (Q58) than for those who strongly disagreed. In summary, responses to the satisfaction questions provide useful insights into response patterns for the four trust items.

Trust vs. Pavement/Non-Pavement Beliefs and Selected Demographic/Vehicle Variables

As was true with the Phase II survey response analysis, the satisfaction items outperformed the demographic/vehicle items in terms of statistically-significant relationships. Reported in this section, therefore, are only a few of the latter variables which had significant Xtab results. Parallel to the Phase II analysis of the trust questions, a number of the pavement and non-pavement items exhibited statistically-significant Xtab relationships. As such, they are the primary focus of this section. Consistent with the preceding section, the results are organized in relation to the four trust questions.

Q51 (WisDOT capable, etc.)

For this first trust item, the Xtab results yielded statistically-significant relationships for one pavement and two non-pavement belief items. Drivers who strongly disagreed that their vehicle had extra wear from driving on their section's pavement (Q32) were considerably more likely to strongly agree that WisDOT is capable for doing a good job of fixing and replacing pavements than were those who strongly agreed [SD 46.5% vs. SA 15%]. As to the non-pavement items, significant associations were found for questions 43 and 45. Strong agreement with WisDOT's capability was twice as likely for motorists who strongly agreed that they would feel comfortable pulling onto the shoulder of their pavement section (Q43) than for those who strongly disagreed [SA 38.8% vs. SD 19.3%]. Likewise, selection of "strongly agree" on this trust item was substantially more frequent for respondents who strongly agreed that the lines on their pavement section were clear (Q45) than for those who strongly disagreed [SA 58.2% vs. SD 7.4%].

One vehicle characteristic item was also significantly related with this trust question. Drivers who rated their vehicle's quality of ride as "very good" (Q103) were much more likely to strongly agree that WisDOT is capable than were those who chose ratings of "very poor or poor" [Very Good (VG) 41.5% vs. Very Poor or Poor (VP/P) average of 2.8%]

Q52 (Trust WisDOT's judgement, etc.)

Emerging from the Xtab analysis for this second trust question were significant associations not only for the same three pavement/non-pavement items, but also three additional pavement belief questions.

First, for the pavement beliefs, respondents who strongly disagreed that their vehicle had extra wear from driving on their section's pavement (Q32) were much more likely to strongly agree that they trust WisDOT's judgement than were those who strongly agreed [SD 51.8% vs. 15.3%]. Choice of "strongly agree" on this trust item was more frequent for drivers who strongly disagreed that their pavement section produced a bumpy ride (Q34) than for those who strongly agreed. At the same time, strong agreement

with this trust item was more likely for motorists who strongly disagreed that their section's pavement caused them to focus their attention on the pavement surface (Q36) than for those who strongly agreed [SD 43.2% vs. 18.4%]. Likewise, drivers who strongly disagreed that driving on their section's pavement was noisy (Q38) chose "strongly agree" on this trust item more often than did those who strongly agreed [SD 42.8% vs. SA 15.3%].

As to the non-pavement items, strong agreement with this trust item was considerably more frequent for motorists who strongly agreed that they would feel comfortable pulling onto the shoulder of their pavement section (Q43) than for those who strongly disagreed [SA 49.5% vs. SD 17.1%]. As the same time, selection of "strongly agree" on this trust item was substantially more likely for drivers who strongly agreed that the lines on their pavement section were clear (Q45) than for those who strongly disagreed [SA 62.2% vs. SD 8.1%]. As such, the findings for these particular pavement and non-pavement belief items were quite consistent.

As with the previous trust item, one vehicle characteristic item was significantly related. Respondents who had a commercial driver's license (CDL) were somewhat less likely to strongly agree that they trusted WisDOT's judgement than were those who did not have a CDL (Q105).

Q53 (WisDOT cares, etc.)

Of the four trust items, question 53 had the most statistically-significant relationship with the variables highlighted in this section. These included all five pavement beliefs, two non-pavement items, and one vehicle characteristic. Drivers who strongly disagreed that their vehicle had extra wear from driving on their section's pavement (Q32) were much more likely to strongly agree that WisDOT cares about drivers' needs than were those who strongly agreed [SD 53.3% vs. SA 12.2%]. Similarly, strong agreement with this trust item was more frequent for motorists who strongly disagreed that their pavement section produced a bumpy ride (Q34) than for those who strongly agreed [SD 42.1% vs. SA 16.4%]. At the same time, respondents who strongly disagreed that their section's pavement caused them to focus attention on the pavement surface (Q36) chose "strongly agree" on this trust item much more often than did those who strongly agreed [SD 49% vs. SA 12.2%].

Strong agreement with this trust item, moreover, was much more frequent for drivers who strongly disagreed that driving on their section's pavement was noisy (Q38) than for those who strongly agreed [SD 43.8% vs. SA 11.2%]. Finally, section of "strongly agree" that WisDOT cares was made by over half (52.5%) of the respondents who strongly disagreed that their pavement section looked "patchy" (Q40). Consistency was evident across these findings.

As to the non-pavement items, motorists who strongly agreed that they would feel comfortable pulling onto the shoulder of their pavement section (Q43) were more likely to strongly agree that WisDOT cares than were those who strongly disagreed [SA 46.4% vs. SD 17.4%]. Likewise, strong agreement with this trust item was substantially more likely for drivers who strongly agreed that the lines on their pavement section were clear (Q45) than for those who strongly disagreed [SA 63.8% vs. SD 8.2%].

Finally, as with trust item Q51, the vehicle characteristic of ride quality (Q103) was significantly associated with this trust question. Selection of "strongly agree" that WisDOT cares was considerably more frequent for respondents who rated their vehicle's quality of ride as "very good" than for those who chose ratings of "very poor or poor" [VG 45.1% vs. VP/P average of 1.5%].

Q53a (WisDOT considers input, etc.)

For this final trust item, the significant findings included the same two non-pavement questions that were relevant for the other three trust items. Strong agreement that WisDOT heeds drivers' input was much more frequent for motorists who strongly agreed that they would feel comfortable pulling onto the shoulder of their pavement section (Q43) than for those who strongly disagreed [SA 42.3% vs. SD 21.4%]. Likewise, drivers who strongly agreed that the lines on pavement section were clear (Q45) were significantly more likely to strongly agree that WisDOT considers input than were those who strongly disagreed [SA 62.1% vs. SD7.1%].

In summary, for the four trust questions, statistically-significant relationships were found for the satisfaction questions, both pavement and non-pavement beliefs, and some vehicle characteristic items.

Table 6.7

Relationships Among Survey Variables

TRUST QUESTIONS	**Related Variables**
WisDOT is capable of doing a good job of pavement repair (Q51). [86.5% agree (SA or SWA)]	Respondents who strongly disagreed that their vehicle had extra wear from driving on their section's pavement (Q32) were much more likely to strongly agree that WisDOT is capable of doing a good job of fixing and replacing pavements than were those who strongly disagreed [Strongly Disagreed (SD) 46.5% vs. Strongly agree (SA) 15%]. Selection of "strongly agree" on WisDOT's capability was twice as likely for motorists who strongly agreed that they would feel comfortable pulling onto the shoulder of their pavement section (Q43) than for those who strongly disagreed [SA38.8% vs. SD 19.3%]. Strong agreement with WisDOT's capability was considerably more frequent for drivers who strongly agreed that the lines on their pavement section were clear and easy to see (Q45) than for those who strongly disagreed [SA 58.2% vs. SD 7.4%]. Motorists who were very satisfied with the pavement (Q57) were substantially more likely to strongly agree that WisDOT is capable than were those who strongly disagreed [Very Satisfied (VS) 50% vs. Very dissatisfied (VD) 13.8%]. Choice of "strongly agree" on WisDOT's capability was made by over half (53.2%) of the drivers who strongly disagreed that their pavement should be improved (Q59).

Strong agreement with WisDOT's capability was significantly more frequent for respondents who rated their vehicle's quality of ride (Q103) as "very good" than those who chose ratings of "very poor or poor" [Very Good (VG) 41.5% vs. Very Poor or Poor (VP/P) average of 2.8%].

Trust WisDOT's judgement in scheduling pavement improvement (Q52).
[72.3% agree]

Drivers who strongly disagreed that their vehicle had extra wear from driving on their section's pavement (Q32) chose "strongly agree" for this trust item much more frequently than did those who strongly agreed [SD 51.8% vs. SA 15.3%].

Strong agreement with this trust item was more likely for motorists who strongly disagreed that their pavement section produced a bumpy ride (Q34) than for those who strongly agreed.

Trusting WisDOT's judgement was more likely for respondents who strongly disagreed that their section's pavement caused them to focus their attention on the pavement surface (Q36) than for those who strongly agreed [SD 43.2% s. SA 18.4%].

Motorists who strongly disagreed that driving on their section's pavement was noisy (Q38) chose "strongly agree" for this trust item more often than did those who strongly agreed [SD 42.8% vs. SA 15.3%].

Selection of "strongly agree" on this trust item was much more frequent for drivers who strongly agreed that they would feel comfortable pulling onto the shoulder of their section's pavement (Q43) than for those who strongly disagreed [SA 49.5% vs. SD 17.1%].

Strong agreement with this trust item was substantially more likely for respondents who strongly agreed that the lines on their pavement section were clear (Q45) than for those who strongly disagreed [SA 62.5% vs. SD 8.1%].

Drivers who were very satisfied with the pavement (Q57) were considerably more likely to strongly agree with this trust item than were those who were very dissatisfied [VS 55.4% vs. VD 15.8%].

Trusting WisDOT's judgement was somewhat more likely for motorists who strongly agreed that their pavement section was better than most other (Q58) than for those who strongly disagreed.

Choice of "strongly agree" on this trust item was made by 40.5% of the drivers who strongly disagreed that their pavement section should be improved (Q59).

Respondents who had a commercial driver's license (CDL) were somewhat less likely to strongly agree with this trust item than were those who did not have a CDL (Q105).

WisDOT cares about the safety and convenience of Wisconsin drivers (Q53). [80% agree]

Strong agreement that WisDOT cares about drivers' needs was considerably more likely for motorists who strongly disagree that their vehicle had extra wear from driving on their section's pavement (Q32) than were those who strongly agreed [SD 53.5% vs. SA 12.2%].

Selection of "strongly agree" that WisDOT cares was more frequent for respondents who strongly disagreed that their pavement section produced a bumpy ride (Q34) than for those who strongly agreed [SD 42.1% vs. SA 16.4%].

Drivers who strongly disagreed that their section's pavement causes them to focus their attention on the pavement surface (A36) were considerably more likely to strongly agree that WisDOT cares than were those who strongly agreed [SD 49% vs. SA 12.2%].

Strong agreement with this trust item was much more frequent for motorists who strongly disagreed that driving on their section's pavement was noisy (Q38) than for those who strongly agreed [SD 43.8% vs. SA 11.2%].

Choice of "strongly agree" that WisDOT cares was made by over half (52.5%) of the drivers who strongly disagreed that their pavement section looked patchy" (Q40).

Respondents who strongly agreed that they would feel comfortable pulling onto the shoulder of their pavement section (Q43) selected "strongly agree" on this trust item more often than did those who strongly disagreed [SA 46.4% vs. SD 17.4%].

Motorists who strongly agreed that the lines on their pavement section were clear (Q45) were substantially more likely to strongly agree that WisDOT cares than were those who strongly disagreed [SA 63.8% vs. SD 8.2%].

Strong agreement that WisDOT cares was much more frequent for drivers who were very satisfied with their pavement (Q57) than for those who were dissatisfied [VS 57.9% vs. VD 10.5%].

Selection of "strongly agree" on this trust item was somewhat more frequent for respondents who strongly greed that their pavement section was better than most others (Q58) than for those who strongly disagreed.

Drivers who strongly disagreed that their pavement section should be improved (Q59) were more likely to strongly agree with this trust item than those who strongly agreed [SD 34.2% vs. SA 16.8%].

Strong agreement that WisDOT cares was significantly more frequent for respondents who rated their vehicle's quality of ride (Q103) as "very good" than for those who chose ratings of "very poor or poor" [Very Good (VG) 45.1% vs. Very Poor and Poor (VP/P) average 1.5%].

WisDOT considers input from Wisconsin drivers (Q53a).
[62.9% agree]

Choice of "strongly agree" that WisDOT considers drivers' input was much more frequent for motorists who strongly greed that they would feel comfortable pulling onto the shoulder of their pavement section (Q43) than for those who strongly disagreed [SA 42.3% vs. SD 21.4%].

Respondents who strongly agreed that the lines on their pavement section were clear (Q45) chose "strongly agree" that WisDOT heeds input substantially more often than did those who strongly disagreed [SA 62.1% vs. SD 7.1%].

Strong agreement with this trust item was considerably more frequent for drivers who were very satisfied with the pavement (Q57) than for those who were very dissatisfied [VS 52.7% vs. VD 16.5].

Selection of "strongly agree" that WisDOT considers input was more frequent for motorists who strongly greed that their pavement section was better than most others (Q58) than for those who strongly disagreed that it was better than most others in Wisconsin.

7. SUMMARY AND CONCLUSIONS

Sampling

The stratified sample furnished by WisDOT and the participants recruited by the WSRL provided a sample adequate for purposes of fulfilling the objectives of Phase III. The sample as furnished by the DOT was skewed towards better pavement quality based on PDI, because approximately 75 percent of the survey was on pavements rated "fair" or better (**Table 1.3**). However, the sample based on IRI was skewed toward poorer quality pavements, because approximately 70 percent of the responses were on pavements rated "fair" or poorer (**Table 1.2**). The team believes this shows a balanced sample, and the differences in pavement quality between the two indices are the result of the IRI boundaries for the categories. The categories in the two indices should be in closer agreement, although they measure different characteristics.

The sample size was adequate to show differences in means of those indicating they were satisfied. These differences showed up in IRI only between Flexible and Rigid Pavements. Differences in PDI showed up between the regions, the pavement types and between South Arterials and South Collectors. Because the differences were only minor in IRI and substantial in PDI, the analyses in Part 4 was undertaken to explore their impact on thresholds.

Results - Satisfaction Thresholds

Phase III results paralleled those of Phase II. In Phase III, 67 percent indicated satisfaction with the segments they were assigned to drive, and 48.5 percent indicated the pavements should be improved (vs. 80% and 54.7% respectively in Phase II). Those differences are the result of the more stratified sample in Phase III. Approximately 18 percent agreed they were satisfied (Q 57) and the pavement needed improvement (Q 59) and this was analyzed along with other relationships for a better understanding of results.

The mean IRI of those satisfied with Rigid pavements was slightly higher than that of those satisfied with Flexible pavements (approximately 2.3 to 2.1 respectively). This means drivers were more tolerant of a lower quality ride of Rigid pavements than that of Flexible pavements. There were significant differences between mean PDI by region, by pavement type and between South Arterials and South Collectors and threshold data presented for each pavement category.

When threshold results were analyzed as in Phase II, there were substantial similarities in thresholds and the curves plotted in **Figures 3.1 and 3.2**. Differences were due to use of a more stratified sample in Phase III. For this reason a different approach to analyses was used to interpret threshold data.

Direct correlations between IRI and satisfaction (**Table 3.3**) increased approximately 50 percent (0.13 to 0.19) as predicted due to better control of segment physical data. The correlations for PDI are not comparable between the two phases since only PDI Flex was used in Phase II. But these direct correlations still explain less than 5 percent of the variation in satisfaction. Therefore as in Phase II, a psychological model is employed to explain as much of the variance as possible from the survey data.

A different approach, using assumptions about respondents answers was used to develop a tool to allow the DOT to answer questions about specific thresholds of physical indices, how many would be satisfied and how many would agree with improvement. The assumptions are as follows:

1) if a pavement of a given quality results in satisfaction for a particular respondent, then it is presumed pavements of higher quality would also result in satisfaction;

2) if a pavement of a given quality is deemed to need improvement for a particular respondent, then it is presumed pavements of lower quality would also be deemed to need improvement.

Since satisfaction is a multi-dependent variable, that may not always be true, and this needs to be recognized, or else physical indices alone would account for most variance in satisfaction.

In Part 4, thresholds are developed for both IRI and PDI, by pavement type, for use of WisDOT. Thresholds for IRI are shown in **Table 4.1**, and are also shown for **Figures 4.1 through 4.3**. For example, if Wisconsin, based on this survey data, wanted to set a threshold around 2.0 for Flexible pavement improvement (middle of the "fair" category), about 45 percent would be satisfied, and about 45 percent would think it needed improvement (interpreting from **Figure 4.2**). This happens to be the intersection of the cumulative responses to Q57 (satisfied) and Q 59 (needs improvement). This would be an "optimum" IRI, i.e. any better quality pavement (lower IRI number) would satisfy more of the public, but result in less agreeing it should be improved. Any lower quality level IRI (higher IRI number) would find more agreeing pavements needed improvement, but less being satisfied. These applications are qualified, however, with the reminder that physical indices alone do not determine satisfaction, or need for improvement.

Similar analyses for Rigid pavements indicate the Q 57 and Q59 crossover or intersection point (**Figure 4.3**) is at an IRI of 2.6 and a cumulative percent of 40, below the middle of the "poor" quality category. As stated previously, residents are apparently more tolerant of poorer ride on rigid pavements than on Flexible pavements (This also occurred in Iowa).

The differences in IRI are near the point where they are not practically different. If a single index for all pavements is desired, IRI seems to be more universal with fewer differences between regions, pavement types or classification. Recognizing differences in IRI measurements however, WisDOT may want to have separate thresholds if a difference of 0.3 to 0.4 in IRI for satisfaction is deemed significant. The differences in IRI for "should be improved") were in the same range. Measurement differences between Flexible and Rigid pavements may account for any difference. The team believes the categories for IRI ("good", "fair" etc. need to be adjusted however to correspond more closely to PDI pavement ratings.

When this type of analysis was applied to PDI, there were substantial differences between regions, pavement types and some difference between Arterials and Collectors. The team believes these differences are partly due to the sample skew. A review of **Table I.1** indicates 81 percent (186/229) of the sample of Rigid pavements are in the "very good" or "good" categories of PDI. Hence levels of satisfaction or need to improve are above the quality categories from the results of the IRI discussed in this section.

An "optimum" PDI (crossover or intersection point of cumulative responses to Q 57 and Q 59) of 34 (near lower boundary of the "good" condition) for all pavements (**Figure 4.4**) would include about 48 percent of those satisfied, and include 48 percent of those agreeing it needed improvement. Any higher or lower PDI would have the same affects described for IRI. Any better quality pavement (lower PDI number) would satisfy more of the public, but result in less agreeing it should be improved. Any lower quality level PDI (higher PDI number) would find more agreeing pavements needed improvement, but less being satisfied.

As noted, there are differences between regions, pavement types and some classes and the impact on thresholds are summarized here. The "optimum" PDI for all North pavements (**Figure 4.5**) is a PDI of 40 (best of the "fair" category), while the "optimum" PDI for all South pavements (**Figure 4.6**) is a PDI of 30 (middle of the "good" category). If a state-wide value is used, that for all pavements (PDI of 34) falls just about midway between that for North and South pavements.

The "optimum" PDI for all Flexible pavements (**Figure 4.7**) is a PDI 43 (near the best of the "fair" category) while the same value for Rigid pavements (**Figure 4.8**) is a PDI of 22 (near best of the "good" category. Again, these differences are believed due to the skew of the sample. Separate values are not recommended because of this. Since the differences between South Arterials and South Collectors were also noted, these differences show up in "optimum" PDIs as well. The "optimum" PDI of South Arterials (**Figure 4.9**) is a PDI of 30 (middle of the "good" category, but identical to that of all South pavements). The "optimum" PDI for South Collectors (**Figure 4.10**) is 40 (best of "fair" category, and different than all South pavements). If a PDI difference of 10 is substantial to WisDOT (the team considers this to be different) a poorer threshold for Collectors could be established. In reality, this difference in a subjective index (PDI) may not be sufficient to set different improvement thresholds for Collectors, since there are no differences noted in public satisfaction between highway classifications in the objective IRI measure.

Results - Psychological Model

Since physical indices alone do not explain satisfaction, the **"Expectancy Value Theory of Fishbein and Ajzen"** was used. Beliefs about pavements (Cognitive Structure) again intervene, as in Phase II, with improved path coefficients. The strength of the relationships in **Figure 5.2** are strong, and explain approximately 70 percent of the total variance. Application of the Expectancy Value Theory again showed improved understanding of other variables affecting satisfaction. In general, analysis of the Phase 3 Wisconsin data confirm the robustness of the model. This is especially true of the core relationships among physical data, cognitive structure, and satisfaction. These findings have been replicated in the analyses of the Iowa and Minnesota data. The model continues to work well not only as an explainer of satisfaction with pavements but also as a diagnostic tool. The relationships between physical data and cognitive structure continue to be impressive and consistent with expectations. The model illustrates that variables such as 1) trust in the DOT, 2) subjective norms, 3) beliefs about the pavement and 4) beliefs about some non-pavement characteristics are important considerations when attempting to understand driver satisfaction.

Results - Special Analyses

The 138 respondents who SA or A with both Q 57 (satisfied with pavement) and Q 59 (needs

improvement) were analyzed to find out why they agreed with both. There are 89 respondents who had only pavement reasons why they believed the pavement should be improved. Further analysis of all 383 drivers who SA or A the pavement should be improved showed 122 listed non-pavement reasons as one of the reasons for improvement. Disagreement that there was a safe shoulder to pull onto and agreement there was a lot of traffic were the two highest non-pavement beliefs given by those 122 drivers, although there was a scattering among all the non-pavement beliefs. It should be noted that the total number who SDA or DA that they felt comfortable pulling onto the shoulder was 289 or 36 percent of the total response. More than half of that number however did not agree the pavement should be improved.

There was low response continuity between pavement beliefs and reasons listed for agreeing the pavement should be improved. The reasons listed for improvement were analyzed by pavement type and the responses were distributed in proportion to their representation in the sample. Therefore, it is believed that the pavement type alone did not influence the decision to improve.

The need for improvement and pavement beliefs were also compared to the drivers self evaluation of their vehicle's ride and their responses showed low correlation. In fact, almost 2/3 of those who agreed with improve and agreed with pavement beliefs affecting ride rated their ride "very good" or "good", so the team believes the vehicle ride did not impact drivers decision to agree with the need to improve.

These are just a few examples of the use to which the survey data can be put to answer specific questions about reasons for the responses. Survey data is being furnished in electronic form in the event WisDOT wishes to pursue further special analyses.

Results - Trust and Select Variables

The trust in WisDOT responses varied from slightly to significantly higher (3 to 20 percent) in Phase III than in Phase II in all four questions, indicating again, high levels of trust. The greatest level (82.3 percent) agreed that the WisDOT is capable of doing a good job in pavement repair. Levels of satisfaction differed in the two phases as well, but that is believed to be a part of the sample differences, because there was more of an oversampling of better pavements in Phase II when motorists selected their own regularly driven section of highway..

When Xtab analyses were performed between satisfaction and all four trust questions, in general, it can be said that those who were more satisfied with the pavement, thought it was better than most and disagreed the pavement needed improvement, were more likely to agree WisDOT was capable, trusted their judgement, believed WisDOT cared about their safety and convenience and considered their input. Another way of saying it is that better pavements lead to higher trust.

Xtab analyses were also performed between each of the pavement and non-pavement beliefs as well. Agreement with trust items correlated highly with disagreement with some or most (depending on the trust question) of the negative pavement beliefs (example: pavement was bumpy, noisy) and correlated highly with two positive non-pavement beliefs (clear pavement markings and comfortable shoulders). The better vehicle ride quality was judged, the more likely respondents trusted the DOT. One driver type (lack of a

CDL) showed higher trust. Demographics did not affect trust significantly.

Overall, the goals of Phase III were met and numerous relationships explored to help WisDOT answer questions about satisfaction with given pavement improvement thresholds and policies. Trust in the DOT and many other variables, again, as in Phase II, help explain just how complicated satisfaction. with pavements can be, and what other beliefs and demographics affect trust and satisfaction.

APPENDIX

Wisconsin Code Book and Frequencies

```
************************************
project 3382    n of cases  813.0
....................................


deck01
************************************************************************

question 0c          column(s) 6-6

Can you tell me how many adults 18 or older are LICENSED drivers and
CURRENTLY DRIVE and live in your household ?

  n      %
-----  ------
  197   24.23          1.  ONE
  536   65.93          2.  TWO
   64    7.87          3.  THREE
   14    1.72          4.  FOUR
    2    0.25          5.  FIVE
    0    0.00          6.  SIX
    0    0.00          7.  SEVEN
    0    0.00          8.  EIGHT OR MORE

    0    0.00          9.  DON'T KNOW / REFUSED

************************************************************************

question 0e          column(s) 7-7

How many MEN living there are 18 or older and licensed drivers ?
  n      %
-----  ------
  112   13.78          0.  NONE
  644   79.21          1.  ONE
   53    6.52          2.  TWO
    4    0.49          3.  THREE OR MORE

    0    0.00          9.  REFUSED / DK

************************************************************************
Question 0f          column(s) 8-8

And how many WOMEN living there are 18 or older and licensed drivers ?

  n      %
-----  ------
  108   13.28          0.  NONE
  654   80.44          1.  ONE
   45    5.54          2.  TWO
    6    0.74          3.  THREE OR MORE

    0    0.00          9.  REFUSED / DK
```

****

question 1d column(s) 9-10

CURRENT MONTH FROM COMPUTER'S CLOCK

n	%	
0	0.00	01. JANUARY
0	0.00	02. FEBRUARY
0	0.00	03. MARCH
0	0.00	04. APRIL
0	0.00	05. MAY
0	0.00	06. JUNE
0	0.00	07. JULY
0	0.00	08. AUGUST
0	0.00	09. SEPTEMBER
426	52.40	10. OCTOBER
339	41.70	11. NOVEMBER
48	5.90	12. DECEMBER
0	0.00	98. DON'T KNOW
0	0.00	99. REFUSED

****

question 1f column(s) 11-12

CURRENT DAY FROM COMPUTER'S CLOCK

n	%	
39	4.80	01. 1ST
27	3.32	2.
15	1.85	3.
15	1.85	4.
12	1.48	5.
29	3.57	6.
19	2.34	7.
29	3.57	8.
26	3.20	9.
21	2.58	10.
17	2.09	11.
12	1.48	12.
31	3.81	13.
27	3.32	14.
29	3.57	15.
13	1.60	16.
31	3.81	17.
47	5.78	18.
38	4.67	19.
32	3.94	20.
38	4.67	21.
38	4.67	22.
38	4.67	23.
24	2.95	24.
44	5.41	25.

n	%		
28	3.44	26.	
36	4.43	27.	
10	1.23	28.	
22	2.71	29.	
19	2.34	30.	
7	0.86	31.	31ST
0	0.00	98.	DON'T KNOW
0	0.00	99.	REFUSED

****

question 2 column(s) 13-14

(The section is Wisconsin state highway {STATE HIGHWAY NAME} from {TOWN FROM} to {TOWN TO} starting at {STARTING POINT} and ending at {ENDING POINT}.)

What date did you drive this section ?

n	%		
0	0.00	01.	JANUARY
0	0.00	02.	FEBRUARY
0	0.00	03.	MARCH
0	0.00	04.	APRIL
0	0.00	05.	MAY
0	0.00	06.	JUNE
0	0.00	07.	JULY
0	0.00	08.	AUGUST
0	0.00	09.	SEPTEMBER
475	58.43	10.	OCTOBER
295	36.29	11.	NOVEMBER
43	5.29	12.	DECEMBER
0	0.00	98.	DON'T KNOW/NOT SURE (skip to q 28)
0	0.00	99.	REFUSED (skip to q 28)

****

question 2a column(s) 15-16

DAY OF THE MONTH

n	%		
23	2.83	01.	1ST
16	1.97	2.	
20	2.46	3.	
20	2.46	4.	
23	2.83	5.	
22	2.71	6.	
23	2.83	7.	
31	3.81	8.	

22	2.71	9.
21	2.58	10.
18	2.21	11.
19	2.34	12.
30	3.69	13.
23	2.83	14.
22	2.71	15.
26	3.20	16.
47	5.78	17.
36	4.43	18.
42	5.17	19.
26	3.20	20.
41	5.04	21.
35	4.31	22.
27	3.32	23.
32	3.94	24.
48	5.90	25.
22	2.71	26.
24	2.95	27.
23	2.83	28.
17	2.09	29.
22	2.71	30.
12	1.48	31. 31ST
0	0.00	98. DON'T KNOW
0	0.00	99. REFUSED
0	0.00	^. INAP

****

question 28 column(s) 17

(The section is Wisconsin state highway {STATE HIGHWAY NAME} from {TOWN FROM} to {TOWN TO} starting at {STARTING POINT} and ending at {ENDING POINT}.)

How often do you NORMALLY drive that section ? Would you say more than once a week, once a week, once a month, once a year or never ?

n	%	
272	33.46	1. MORE THAN ONCE A WEEK
185	22.76	2. ONCE A WEEK
257	31.61	3. ONCE A MONTH
73	8.98	4. ONCE A YEAR
25	3.08	5. NEVER
1	0.12	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 32 column(s) 18

Now, I'm going to read some statements that people might make about the pavement on rural highways. Thinking about driving that section, please tell me if you strongly agree, somewhat agree, feel neutral, somewhat disagree, or strongly disagree with each one. Remember, we are only talking about the PAVEMENT right now. First...

Driving on the PAVEMENT on this section causes extra wear on my vehicle's suspension system.

n	%	
116	14.27	1. STRONGLY AGREE
138	16.97	2. SOMEWHAT AGREE
64	7.87	3. FEEL NEUTRAL
152	18.70	4. SOMEWHAT DISAGREE
333	40.96	5. STRONGLY DISAGREE
10	1.23	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 34 column(s) 19

Driving on the PAVEMENT on this section produces a bumpy ride.

n	%	
178	21.89	1. STRONGLY AGREE
192	23.62	2. SOMEWHAT AGREE
49	6.03	3. FEEL NEUTRAL
135	16.61	4. SOMEWHAT DISAGREE
258	31.73	5. STRONGLY DISAGREE
1	0.12	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 36 column(s) 20

Driving on the PAVEMENT on this section causes me to focus my attention on the pavement surface.

(INTERVIEWER: THIS MIGHT INCLUDE THINGS LIKE TURNING DOWN THE RADIO OR STOPPING CONVERSATIONS)

n	%	
120	14.76	1. STRONGLY AGREE
129	15.87	2. SOMEWHAT AGREE
76	9.35	3. FEEL NEUTRAL
177	21.77	4. SOMEWHAT DISAGREE
311	38.25	5. STRONGLY DISAGREE
0	0.00	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 38 column(s) 21

Driving on the PAVEMENT on this section is noisy.

(NOTE: This would INCLUDE noise caused by grooves running across the pavement to improve traction, which can make a high-pitched whining sound. We are NOT talking about rumble strips or bars.)

n	%		
115	14.15	1.	STRONGLY AGREE
176	21.65	2.	SOMEWHAT AGREE
61	7.50	3.	FEEL NEUTRAL
197	24.23	4.	SOMEWHAT DISAGREE
263	32.35	5.	STRONGLY DISAGREE
1	0.12	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 40 column(s) 22

The pavement on this section looks "patchy".

n	%		
181	22.26	1.	STRONGLY AGREE
173	21.28	2.	SOMEWHAT AGREE
56	6.89	3.	FEEL NEUTRAL
189	23.25	4.	SOMEWHAT DISAGREE
211	25.95	5.	STRONGLY DISAGREE
3	0.37	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 43 column(s) 23

Now I would like to read some statements about other, NON-PAVEMENT, characteristics of this section using the same scale.

I would feel comfortable pulling on to the shoulder on this section if I had to. (This is not refering to the PAVEMENT on the shoulder.)

n	%		
260	31.98	1.	STRONGLY AGREE
219	26.94	2.	SOMEWHAT AGREE
43	5.29	3.	FEEL NEUTRAL
115	14.15	4.	SOMEWHAT DISAGREE
174	21.40	5.	STRONGLY DISAGREE
2	0.25	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 44 column(s) 24

There is a lot of traffic on this section.

n	%	
315	38.75	1. STRONGLY AGREE
206	25.34	2. SOMEWHAT AGREE
78	9.59	3. FEEL NEUTRAL
129	15.87	4. SOMEWHAT DISAGREE
82	10.09	5. STRONGLY DISAGREE
3	0.37	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 45 column(s) 25

The lines on this section are clear and easy to see.

n	%	
409	50.31	1. STRONGLY AGREE
207	25.46	2. SOMEWHAT AGREE
38	4.67	3. FEEL NEUTRAL
72	8.86	4. SOMEWHAT DISAGREE
74	9.10	5. STRONGLY DISAGREE
13	1.60	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 46 column(s) 26

The scenery on this section is attractive.

n	%	
329	40.47	1. STRONGLY AGREE
289	35.55	2. SOMEWHAT AGREE
92	11.32	3. FEEL NEUTRAL
64	7.87	4. SOMEWHAT DISAGREE
36	4.43	5. STRONGLY DISAGREE
3	0.37	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 47 column(s) 27

This section is very curvy.

n	%	
115	14.15	1. STRONGLY AGREE
144	17.71	2. SOMEWHAT AGREE
58	7.13	3. FEEL NEUTRAL
149	18.33	4. SOMEWHAT DISAGREE
347	42.68	5. STRONGLY DISAGREE
0	0.00	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 48 column(s) 28

This section is very hilly.

n	%	
98	12.05	1. STRONGLY AGREE
155	19.07	2. SOMEWHAT AGREE
41	5.04	3. FEEL NEUTRAL
170	20.91	4. SOMEWHAT DISAGREE
344	42.31	5. STRONGLY DISAGREE
5	0.62	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 51 column(s) 29

Now, I would like to read you some general statements about the DOT, driving, and that section still using the same scale.

The state DOT is CAPABLE of doing a good job of fixing and replacing pavements on rural highways in Wisconsin.

n	%	
348	42.80	1. STRONGLY AGREE
349	42.93	2. SOMEWHAT AGREE
51	6.27	3. FEEL NEUTRAL
37	4.55	4. SOMEWHAT DISAGREE
24	2.95	5. STRONGLY DISAGREE
4	0.49	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 52 column(s) 30

I trust the JUDGEMENT of the state DOT when it comes to scheduling pavement improvements.

n	%		
230	28.29	1.	STRONGLY AGREE
355	43.67	2.	SOMEWHAT AGREE
95	11.69	3.	FEEL NEUTRAL
93	11.44	4.	SOMEWHAT DISAGREE
37	4.55	5.	STRONGLY DISAGREE
3	0.37	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 53 column(s) 31

State DOT officials care about the safety and convenience of drivers on this section of road.

n	%		
316	38.87	1.	STRONGLY AGREE
321	39.48	2.	SOMEWHAT AGREE
90	11.07	3.	FEEL NEUTRAL
56	6.89	4.	SOMEWHAT DISAGREE
17	2.09	5.	STRONGLY DISAGREE
13	1.60	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 53a column(s) 32

The DOT considers input from people like me when making decisions about repairs or improvements to this section.

n	%		
185	22.76	1.	STRONGLY AGREE
325	39.98	2.	SOMEWHAT AGREE
136	16.73	3.	FEEL NEUTRAL
68	8.36	4.	SOMEWHAT DISAGREE
55	6.77	5.	STRONGLY DISAGREE
44	5.41	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 55 column(s) 33

If I wanted to, I could easily find a convenient alternate route to the places I usually go instead of using this section.

n	%		
279	34.32	1.	STRONGLY AGREE
185	22.76	2.	SOMEWHAT AGREE
40	4.92	3.	FEEL NEUTRAL
99	12.18	4.	SOMEWHAT DISAGREE
209	25.71	5.	STRONGLY DISAGREE
1	0.12	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 56 column(s) 34

Most of the trips I take on this section are trips that I have to take.

n	%		
459	56.46	1.	STRONGLY AGREE
129	15.87	2.	SOMEWHAT AGREE
33	4.06	3.	FEEL NEUTRAL
101	12.42	4.	SOMEWHAT DISAGREE
89	10.95	5.	STRONGLY DISAGREE
2	0.25	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 57 column(s) 35

I am satisfied with the pavement on this section.

n	%		
323	39.73	1.	STRONGLY AGREE
229	28.17	2.	SOMEWHAT AGREE
39	4.80	3.	FEEL NEUTRAL
106	13.04	4.	SOMEWHAT DISAGREE
116	14.27	5.	STRONGLY DISAGREE
0	0.00	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 58 column(s) 36

The pavement on this section is better than most of the sections of state highways I've driven recently in Wisconsin.

n	%	
144	17.71	1. STRONGLY AGREE
234	28.78	2. SOMEWHAT AGREE
131	16.11	3. FEEL NEUTRAL
172	21.16	4. SOMEWHAT DISAGREE
126	15.50	5. STRONGLY DISAGREE
6	0.74	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 59 column(s) 37

The pavement on this section should be improved.

n	%	
204	25.09	1. STRONGLY AGREE
182	22.39	2. SOMEWHAT AGREE
81	9.96	3. FEEL NEUTRAL
159	19.56	4. SOMEWHAT DISAGREE
186	22.88	5. STRONGLY DISAGREE
1	0.12	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 59a column(s) 38-38

Now, I am going to read a list of reasons why you might agree the road should be improved. Please tell me all that apply.

1) The pavement causes extra wear on my vehicle's suspension system.

n	%	
210	25.83	1. YES
164	20.17	2. NO
6	0.74	8. DON'T KNOW/NOT SURE
6	0.74	9. REFUSED
427	52.52	^. INAP

```
**********************************************************************
question 59a          column(s) 39-39

2) It produces a bumpy ride.

  n      %
-----  ------
  290   35.67          1.  YES
   84   10.33          2.  NO

    6    0.74          8.  DON'T KNOW/NOT SURE
    6    0.74          9.  REFUSED

  427   52.52          ^.  INAP
**********************************************************************

question 59a          column(s) 40-40

3) It causes me to focus my attention on the pavement surface
  n      %
-----  ------
  184   22.63          1.  YES
  190   23.37          2.  NO

    6    0.74          8.  DON'T KNOW/NOT SURE
    6    0.74          9.  REFUSED

  427   52.52          ^.  INAP

**********************************************************************

question 59a          column(s) 41-41

4) The pavement is noisy
  n      %
-----  ------
  208   25.58          1.  YES
  166   20.42          2.  NO

    6    0.74          8.  DON'T KNOW/NOT SURE
    6    0.74          9.  REFUSED

  427   52.52          ^.  INAP

**********************************************************************
question 59a          column(s) 42-42
5) It looks patchy

  n      %
-----  ------
  255   31.37          1.  YES
  119   14.64          2.  NO

    6    0.74          8.  DON'T KNOW/NOT SURE
    6    0.74          9.  REFUSED

  427   52.52          ^.  INAP
```

****

question 59a column(s) 43-43

6) Because of a non-pavement reason ?

n	%	
123	15.13	1. YES
251	30.87	2. NO
6	0.74	8. DON'T KNOW/NOT SURE
6	0.74	9. REFUSED
427	52.52	^. INAP

****

question 60 column(s) 44

Most people whose opinions are important to me think that it is OK for me to drive this section.

n	%	
449	55.23	1. STRONGLY AGREE
233	28.66	2. SOMEWHAT AGREE
79	9.72	3. FEEL NEUTRAL
22	2.71	4. SOMEWHAT DISAGREE
16	1.97	5. STRONGLY DISAGREE
13	1.60	8. DON'T KNOW/NOT SURE
1	0.12	9. REFUSED

****

question 100 column(s) 45-46

The next few questions ask for a little more information about yourself.

First, in what year were you born ?

n	%	
0	0.00	09. 1909
1	0.12	12.
1	0.12	14.
2	0.25	15.
2	0.25	16.
1	0.12	17.
3	0.37	18.
2	0.25	19.
3	0.37	20.
2	0.25	21.
6	0.74	22.
6	0.74	23.

7	0.86	24.
3	0.37	25.
8	0.98	26.
5	0.62	27.
7	0.86	28.
12	1.48	29.
8	0.98	30.
6	0.74	31.
6	0.74	32.
6	0.74	33.
5	0.62	34.
5	0.62	35.
15	1.85	36.
13	1.60	37.
5	0.62	38.
17	2.09	39.
17	2.09	40.
6	0.74	41.
11	1.35	42.
8	0.98	43.
16	1.97	44.
17	2.09	45.
14	1.72	46.
17	2.09	47.
16	1.97	48.
14	1.72	49.
14	1.72	50.
15	1.85	51.
15	1.85	52.
29	3.57	53.
25	3.08	54.
19	2.34	55.
26	3.20	56.
18	2.21	57.
23	2.83	58.
22	2.71	59.
19	2.34	60.
17	2.09	61.
20	2.46	62.
20	2.46	63.
19	2.34	64.
22	2.71	65.
8	0.98	66.
22	2.71	67.
27	3.32	68.
14	1.72	69.
19	2.34	70.
16	1.97	71.
11	1.35	72.
12	1.48	73.
15	1.85	74.
8	0.98	75.
12	1.48	76.
8	0.98	77.
6	0.74	78.
7	0.86	79.
4	0.49	80.

3	0.37	81. 1981
0	0.00	98. DON'T KNOW/NOT SURE
5	0.62	99. REFUSED

****

question 101 column(s) 47-47

What kind of vehicle did you USE to drive this section ? Did you drive a car, van, pickup truck, sports utility vehicle, or some other vehicle ?

n	%	
452	55.60	1. CAR
85	10.46	2. MINIVAN/VAN
176	21.65	3. PICKUP TRUCK
87	10.70	4. SPORTS UTILITY VEHICLE
2	0.25	5. MOTORCYCLE
9	1.11	6. LARGE TRUCK - SEMI
2	0.25	0. OTHER (SPECIFY:_____)
0	0.00	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 103 column(s) 48

And how would you rate the quality of the ride of the vehicle you used to drive this section ? Would you say it has a very good, good, average, poor, or very poor ride ?

n	%	
314	38.62	1. VERY GOOD
288	35.42	2. GOOD
176	21.65	3. AVERAGE
29	3.57	4. POOR
6	0.74	5. VERY POOR
0	0.00	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 105 column(s) 49

Do you have a CDL or Commercial Driver's License ?

n	%	
93	11.44	1. YES
720	88.56	2. NO
0	0.00	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED

****

question 105a column(s) 50

Do you have a motorcycle license ?

n	%	
114	14.02	1. YES
698	85.85	2. NO (skip to q 108)
1	0.12	8. DON'T KNOW/NOT SURE (skip to q 108)
0	0.00	9. REFUSED (skip to q 108)

****

question 105b column(s) 51

How often did you ride a motorcycle in the last year ? Would you say more than once a week, once a week, once a month, once a year, or never ?

n	%	
25	3.08	1. MORE THAN ONCE A WEEK
19	2.34	2. ONCE A WEEK
19	2.34	3. ONCE A MONTH
9	1.11	4. ONCE A YEAR
42	5.17	0. NEVER
0	0.00	8. DON'T KNOW/NOT SURE
0	0.00	9. REFUSED
699	85.98	^. INAP

****

question 108 column(s) 52-53

What is the highest grade or year of school you completed ?

n	%	
17	2.09	01. EIGHTH GRADE OR LESS
40	4.92	02. SOME HIGH SCHOOL
348	42.80	03. HIGH SCHOOL GRAD OR GED CERTIFICATE
51	6.27	04. SOME TECHNICAL SCHOOL OR VOCATIONAL TRAINING
37	4.55	05. TECHNICAL SCHOOL GRADUATE
134	16.48	06. SOME COLLEGE OR ASSOCIATE DEGREE
125	15.38	07. COLLEGE GRADUATE
59	7.26	08. POST GRAD OR PROFESSIONAL DEGREE
0	0.00	00. OTHER (SPECIFY:_____)
0	0.00	98. DON'T KNOW/NOT SURE
2	0.25	99. REFUSED

****

question 998b column(s) 54

SEX OF RESPONDENT:

n	%	
426	52.40	1. MALE
387	47.60	2. FEMALE

****

question 998e column(s) 55-55

INTERVIEWER: IN WHAT LANGUAGE WAS THIS INTERVIEW DONE ?

n	%	
812	99.88	1. ENGLISH
0	0.00	2. SPANISH
0	0.00	3. MIXED ENGLISH/SPANISH
1	0.12	4. R IS TTY USER/USED WI RELAY OPERATOR
0	0.00	0. OTHER

****

question 998m column(s) 56

SEX OF INTERVIEWER

n	%	
353	43.42	1. MALE
460	56.58	2. FEMALE

****
project 3382 n of cases 813.0
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SPECIAL PHASE II MODIFIED POLICY QUESTIONS

deck02
****

question 70 column(s) 6-7

Pavements begin to wear as soon as they are built. Assuming costs were the same, would you prefer to fix pavements every 10 years with shorter periods of construction related delays, OR fix them every 20 years, with longer periods of construction ? Overall quality of the ride will be the same for both options.

n	%		
645	79.34	01.	10 YEARS
142	17.47	02.	20 YEARS
4	0.49	03.	FIX WHEN NEEDED
7	0.86	00.	OTHER (SPECIFY: _____)
14	1.72	98.	DON'T KNOW/NOT SURE
1	0.12	99.	REFUSED

****

question 71 column(s) 8

If you had to make repairs on a 30 mile stretch of highway you regularly drive, would you chose: 1.) To repair 10 miles for each of the next three years, and tolerate shorter construction periods for each of these three years, or would you choose 2.) To repair all 30 miles of highway in one year, recognizing you may have to tolerate one, longer period of construction ?

n	%		
290	35.67	1.	10 MILES/THREE YEARS
518	63.71	2.	30 MILES/ONE YEAR
5	0.62	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 72 column(s) 9

Would you prefer a construction project that closed a highway to traffic and caused a 30 minute DETOUR for drivers with construction lasting 2 months, OR would you keep the highway open to traffic with a 10 minute delay through the project and NO DETOUR, but with construction lasting 6 months ?

n	%		
279	34.32	1.	CLOSED, 30 MINUTE DETOUR, 2 MONTHS
522	64.21	2.	OPEN, 10 MINUTE DELAY, 5-6 MONTHS
12	1.48	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 73 column(s) 10

If it normally took you 12 minutes to travel a 10 mile stretch of road, which of the following would you consider a reasonable amount of time to travel the same 10 miles while under reconstruction ? Would you say from 15 to 19 minutes, from 20 to 25 minutes, or more than 25 minutes ?

n	%		
326	40.10	1.	FROM 15 TO 19 MINUTES
447	54.98	2.	FROM 20 TO 25 MINUTES
40	4.92	3.	MORE THAN 25 MINUTES
0	0.00	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 74 column(s) 11

And which of the following would you consider an unacceptable time to travel the same 10 mile work zone ? Would you say from 20 to 25 minutes, from 26 to 30 minutes, or more than 30 minutes ?

n	%		
95	11.69	1.	FROM 20 TO 25 MINUTES
217	26.69	2.	FROM 26 TO 30 MINUTES
498	61.25	3.	MORE THAN 30 MINUTES
3	0.37	8.	DON'T KNOW/NOT SURE
0	0.00	9.	REFUSED

****

question 75 column(s) 12

If 10 miles of rural two-lane highway are being reconstructed, and the normal speed limit is 55 MPH, which of the following would you consider a reasonable speed limit through the 10 mile work zone ? Would you say 25 MPH, 35 MPH, or 45 MPH ?

n	%	
163	20.05	1. 25 MPH
468	57.56	2. 35 MPH
179	22.02	3. 45 MPH
2	0.25	8. DON'T KNOW/NOT SURE
1	0.12	9. REFUSED

****

question 76 column(s) 13

And which of the following would you consider an unacceptably slow speed limit through the 10 mile work zone ? Would you say 25 MPH or less, 35 MPH, or 45 MPH ?

n	%	
722	88.81	1. 25 MPH OR LESS
65	8.00	2. 35 MPH
19	2.34	3. 45 MPH
5	0.62	8. DON'T KNOW/NOT SURE
2	0.25	9. REFUSED

****

question 77 column(s) 14-15

If you want longer lasting pavements, is it because you desire to minimize construction interruptions, or you desire an improved quality of ride, or is it because of some other reason?

n	%	
261	32.10	01. MINIMIZE CONSTRUCTION PERIODS
405	49.82	02. PROVIDE A BETTER RIDE
28	3.44	03. BOTH
46	5.66	04. COST FACTOR
24	2.95	05. SAFER ROADS
4	0.49	06. DESTRUCTION BY SEMIS/HEAVY TRAFFIC
12	1.48	07. TRY DIFFERENT MATERIALS FOR LONGER LASTING ROADS/BETTER QUALITY
3	0.37	10. MINIMIZE WEAR ON VEHICLES
8	0.98	00. OTHER (SPECIFY: _____)
17	2.09	98. DON'T KNOW/NOT SURE
5	0.62	99. REFUSED